

Miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant, two-row and four-row



Now with even more possibilities!

Linear bearings for the miniature applications sector require a different approach in the design of guidance systems. While normal criteria such as load carrying capacity, rigidity and operating life are important, the additional factor of size also applies for miniature bearing arrangements. However, simply "scaling down" the standard sizes to smaller dimensions is not very successful in technical terms. INA has therefore developed its four-row miniature linear ball bearing and guideway assembly KUME..C. For applications with a lower requirement for load carrying capacity, this high-performance guidance system is supplemented by a two-row guidance system.

Two-row linear recirculating ball bearing and guideway assemblies

These units have moderate load carrying capacity, the moment load carrying capacity is moderate to high. Their modular construction allows the exchange of guideways and carriages within one interchangeability and accuracy class. This gives simpler fitting of guidance systems, easier sourcing of replacement parts and allows very economical stockholding. The saddle plates and guideways are corrosion-resistant. Seals on the end faces of the carriages protect the rolling element system against contamination. The carriages are greased and can be relubricated. The guideways and carriages are also available in a wide version.

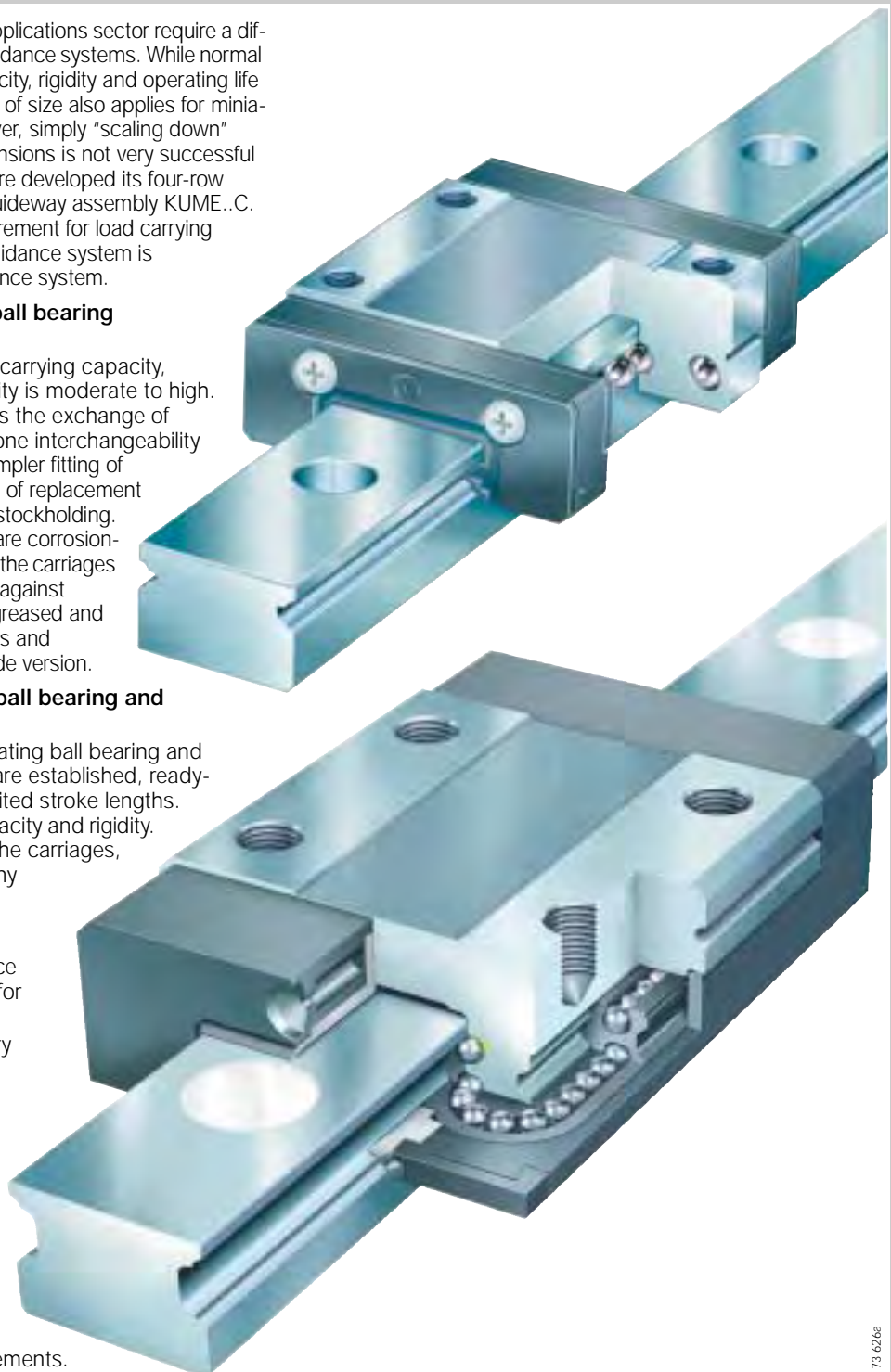
Four-row linear recirculating ball bearing and guideway assemblies

Four-row miniature linear recirculating ball bearing and guideway assemblies KUME..C are established, ready-to-fit guidance systems for unlimited stroke lengths. They have high load carrying capacity and rigidity. Due to the lubricant reservoir in the carriages, they are maintenance-free in many applications.

Applications

These linear recirculating guidance systems are particularly suitable for applications:

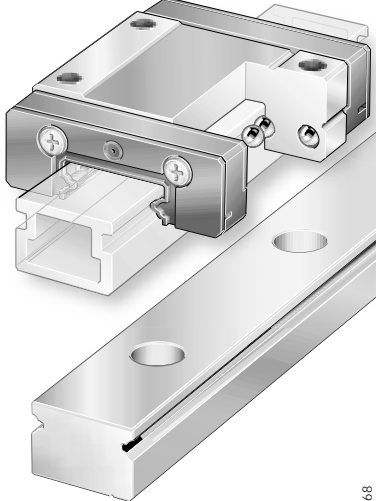
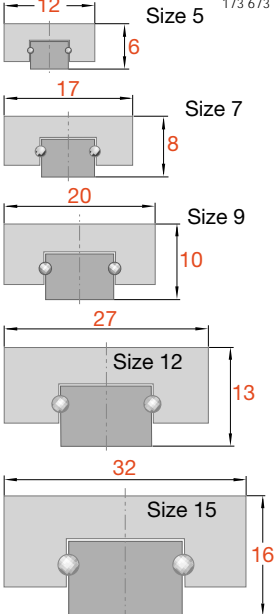
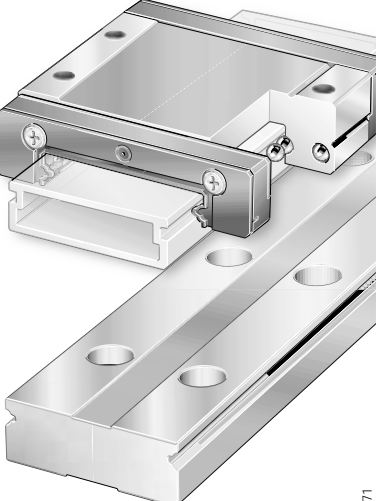
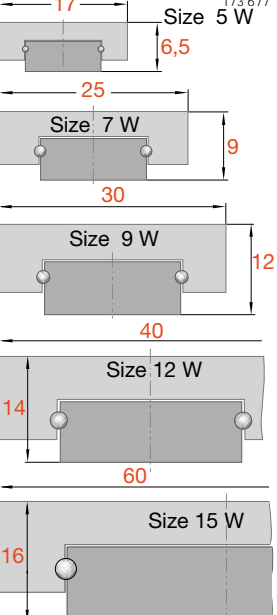
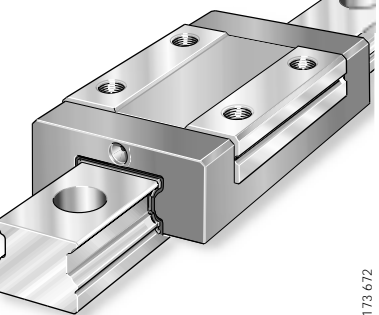
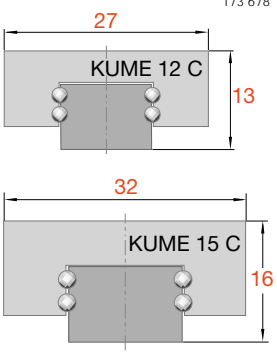
- in the microelectronics industry and related sectors
- in optical equipment
- in medical equipment
- in textile machinery
- that require high speeds and very uniform running behaviour
- where particularly economical miniature guidance systems are needed for moderate to high load requirements and moderate to high rigidity requirements.



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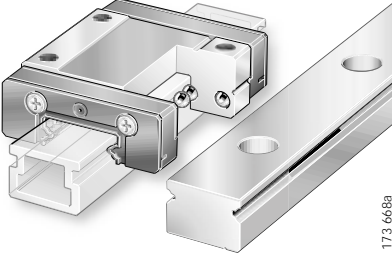
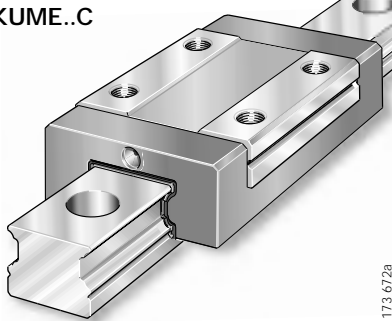
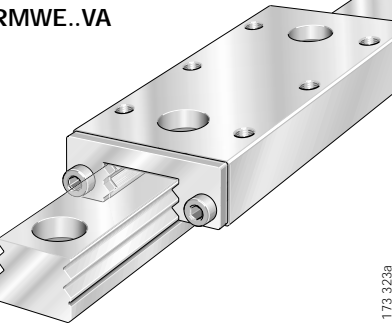
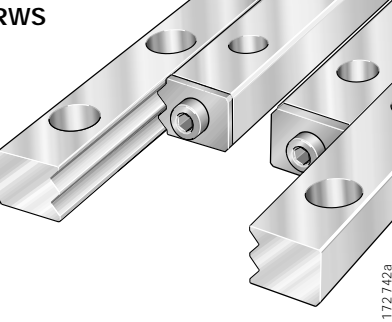
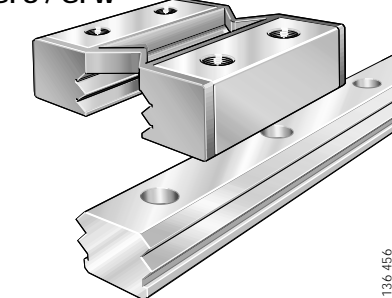
Miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant, two-row and four-row

Feature	Characteristic	Dimensions/cross-section	Load carrying capacity and rigidity
<p>TKDM / KWEM (L, C)</p>  <p>173 668</p>	<ul style="list-style-type: none"> Linear locating bearing for unlimited stroke lengths Comprising guideway TKDM and carriage KWEM Two-row, four point contact of rolling elements with raceways Can support loads from all directions – except for the direction of motion – and moments about all axes Preloaded Seals on end faces of carriages Greased, can be lubricated with oil or grease Also available as long version 	 <p>173 673</p>	<p>Moderate to high</p>
<p>TKDM..W / KWEM..W (WL, WC)</p>  <p>173 671</p>	<ul style="list-style-type: none"> Linear locating bearing for unlimited stroke lengths Wide design Comprising guideway TKDM..W and carriage KWEM..W Two-row, four point contact of rolling elements with raceways Can support loads from all directions – except for the direction of motion – and moments about all axes Preloaded Seals on end faces of carriages Greased, can be lubricated with oil or grease Also available as long version 	 <p>173 677</p>	<p>Moderate to high</p>
<p>KUME..C</p>  <p>173 672</p>	<ul style="list-style-type: none"> Linear locating bearing for unlimited stroke lengths Comprising guideway and carriage Four-row, two point contact of rolling elements with raceways Can support loads from all directions – except for the direction of motion – and moments about all axes Preloaded With lubricant reservoir Seals on end faces of carriages Can be lubricated with oil or grease 	 <p>173 678</p>	<p>High to very high</p>







INA miniature linear guidance systems

Product range

Feature	Characteristic	Load carrying capacity	Rigidity	Information
<p>Miniature linear guidance system</p> <p>TKDM..(W) / KWEM..(L, C, W, WL, WC)</p>  <p>173 668a</p>	<ul style="list-style-type: none"> ■ Linear locating bearing for unlimited stroke lengths ■ Comprising guideway and carriage, not preassembled ■ Two-row, four point contact of rolling elements with raceways ■ Preloaded ■ Seals on end faces of carriages ■ Greased, can be lubricated with oil or grease ■ Interchangeable 	Moderate to high	Moderate to high	MAI 81
<p>KUME..C</p>  <p>173 672a</p>	<ul style="list-style-type: none"> ■ Linear locating bearing for unlimited stroke lengths ■ Comprising guideway and carriage ■ Four-row, two point contact of rolling elements with raceways ■ Preloaded ■ With lubricant reservoir ■ Seals on end faces ■ Can be lubricated with oil or grease 	High to very high	High to very high	MAI 81
<p>RMWE..VA</p>  <p>173 323a</p>	<ul style="list-style-type: none"> ■ Linear locating bearing for limited stroke lengths ■ Comprising guideway and carriage, single or double row cylindrical roller flat cages, end pieces ■ Cylindrical rollers in O or X arrangement ■ Higher load carrying capacity and rigidity than linear recirculating guidance systems in comparable design envelope ■ Very smooth running and high running accuracy ■ Preloaded ■ Greased, can be lubricated with oil or grease 	Very high	Very high	MAI 77
<p>RWS</p>  <p>172 742a</p>	<ul style="list-style-type: none"> ■ Linear locating bearing for limited stroke lengths ■ Comprising guideways, cylindrical roller flat cages, end pieces ■ Cylindrical rollers in O or X arrangement ■ Higher load carrying capacity and rigidity than linear recirculating guidance systems in comparable design envelope ■ Spacing between guidance systems can be selected as required ■ Preloaded ■ Can be lubricated with oil or grease 	Very high	Very high	MAI 79
<p>GFS / GFW</p>  <p>136 456</p>	<ul style="list-style-type: none"> ■ Linear locating bearing for stroke lengths up to 3 m ■ Maintenance-free ■ Comprising guideway and carriage with plain sliding layer ■ Highly suitable for light metal constructions ■ Wear-resistant ■ Insensitive to contamination ■ Adjustable clearance ■ Interchangeable as required 	Low	Low	MAI 78

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

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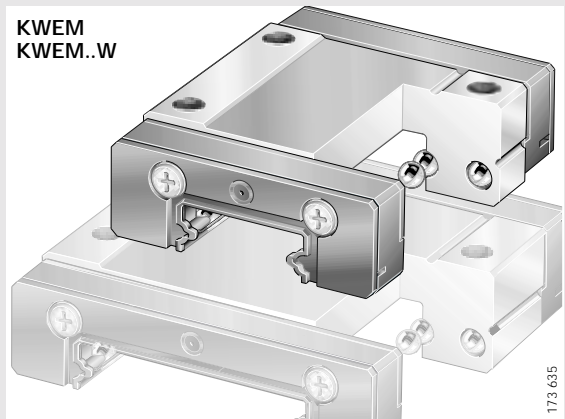
Features

Two-row miniature linear recirculating ball bearing and guideway assemblies

- of this series consist of:
 - at least one narrow or wide carriage made from corrosion-resistant rolling bearing steel with a full complement ball system and one locating face
 - ball retainers in the carriages
 - a narrow or wide guideway made from corrosion-resistant rolling bearing steel with two locating edges
 - the carriage is not supplied mounted on the guideway. There is a plastic dummy guideway in the carriage
- have 2 rows of rolling elements in four point contact with the raceways
- are linear locating bearings
- can support loads from all directions – apart from the direction of motion – and moments about all axes
- are preloaded
- have seals on the end faces of the carriages to seal off the rolling element system
- are designed according to a modular concept. Within the same size and preload class, guideways can be combined with all carriage types (type W guideways can only be combined with type W carriages)
- are greased, but can also be supplied ungreased
- are lubricated via lubrication holes in the end piece of the carriage
 - lubrication nipples are included with size 15
- are suitable for:
 - accelerations up to 50 m/s^2
 - speeds up to 180 m/min
 - operating temperatures from $-40 \text{ }^\circ\text{C}$ to $+100 \text{ }^\circ\text{C}$

Carriages – corrosion-resistant

**KWEM
KWEM..W**



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- saddle plate made from corrosion-resistant, hardened steel, rolling element raceways precision ground
 - balls are recirculated in enclosed channels with plastic return elements
- end pieces with gap seals and lubrication holes
 - lubrication nipple supplied with size 15
- KWEM..W: wide carriage



Guideways - corrosion-resistant

**TKDM
TKDM..W**

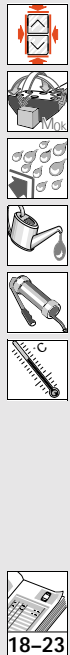


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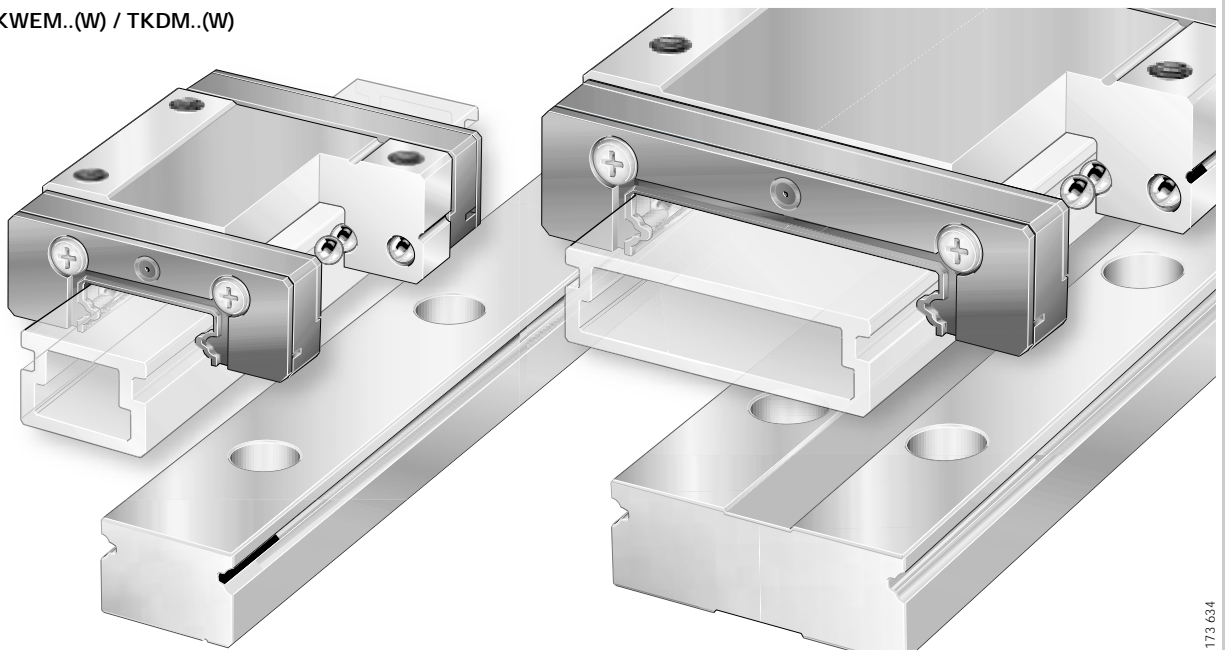
- corrosion-resistant steel, hardened and ground on all faces, rolling element raceways precision ground
- located from above
- one or two rows of holes for fixing screws
 - though holes with counterbores
- TKDM..W: wide guideway



Two-row miniature linear recirculating ball bearing and guideway assemblies - corrosion-resistant



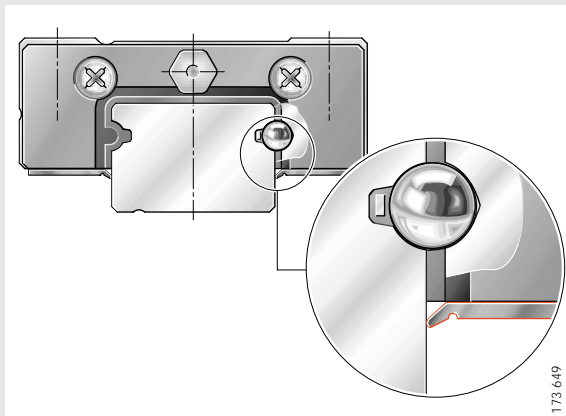
KWEM..(W) / TKDM..(W)



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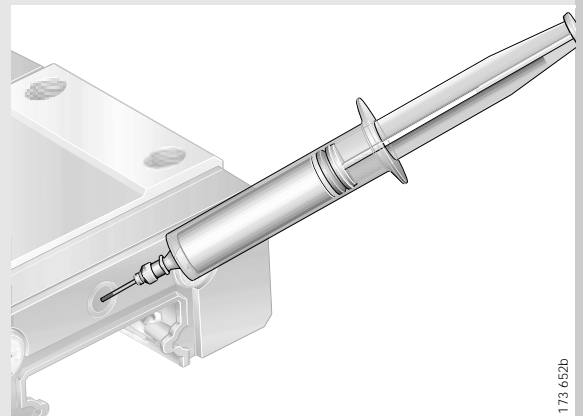
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Accessories



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■ sealing strips for carriages



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■ grease injector for greasing of carriages

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14

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Design and safety guidelines

Load carrying capacity and life

The size of the guidance unit is determined by the load carrying capacity of the individual elements. The load carrying capacity is described in terms of the basic dynamic load rating C and basic static load rating C_0 (*dimension table*).

Basic rating life

The basic rating life is determined as follows:

$$L = \left(\frac{C}{P}\right)^p$$

$$L_h = \frac{8,33 \cdot 10^5}{H \cdot n_{osc}} \cdot \left(\frac{C}{P}\right)^p$$

Static load safety factor

The static load safety factor S_0 indicates the security with regard to permissible permanent deformation in the bearing without affecting the guidance accuracy and smooth running of the bearing.

It can be determined using the following formula:

$$S_0 = \frac{C_0}{P_0}$$

$$S_0 = \frac{M_0}{M}$$



If high demands are placed on accuracy and smoothness of running, the static load safety factor should not be less than $S_0 = 3$.

For high loads, the load carrying capacity of the fixing screws must be checked (see VDI Guideline 2 230).

The equivalent static bearing load is determined by the maximum load F_{max} .

$$P_0 = F_{max}$$

$$M_0 = M_{max}$$

C N
Basic dynamic load rating (*dimension table*)

C_0 N
Basic static load rating (*dimension table*)

H mm
Distance between ends of stroke

L mm
Basic rating life in 100 000 m

L_h h
Basic rating life in operating hours

M Nm
Equivalent static moment in load direction

M_0 Nm
Basic static moment rating in load direction (M_{0x} , M_{0y} , M_{0z} from *dimension table*)

n_{osc} min⁻¹
Number of return strokes per minute

p –
Life exponent $p = 3$

P N
Equivalent dynamic load

P_0 N
Maximum equivalent static load

S_0 –
Static load safety factor.

Conversion

Basic load ratings to DIN, basic load ratings as used in the Far East

Linear recirculating ball bearing and guideway assemblies

$$C_{50000} = 1,26 \cdot C_{DIN}$$

$$C_{DIN} = 0,79 \cdot C_{50000}$$

C_{DIN} N
Basic dynamic load rating C for distance of 100 000 m – definition to DIN 636

C_{50000} N
Basic dynamic load rating C for distance of 50 000 m.

Interchangeability

The guideways and carriages can be used in any combination within the same accuracy and interchangeability class.

This has the following benefits:

- economical stockholding
- simple spare parts sourcing
- straightforward installation.

The preload class is determined by the carriage.

Delivered condition

The carriage ① and guideway ③ are not supplied pre-assembled (Figure 1).

There is a plastic dummy guideway ② in the carriage. This guideway prevents damage to the rolling element set while the carriage is separate from the guideway.

The carriages are greased.

Corrosion-resistant design



The miniature linear recirculating ball bearing and guideway assemblies are corrosion-resistant due to the steels used in the manufacture of the saddle plates and guideways.

If very high levels of corrosion resistance are required, however, the suitability of the unit for the specific application must be investigated.



Preload

Miniature linear recirculating ball bearing and guideway assemblies TKDM (W)/KWEM (L, C, W, WL, WC) are available in the preload classes according to Table 1.

TKDM 5 (W)/KWEM 5 (C, W, WC) is only available in V0.

Increasing the preload has the effect of increasing:

- the rigidity
- the moment load carrying capacity
- the guidance accuracy.

However, preload also influences the displacement resistance and the operating life of recirculating guidance systems.

Table 1 · Preload

Preload class	Preload setting
V0 (standard)	Zero to light preload
V1	Preload

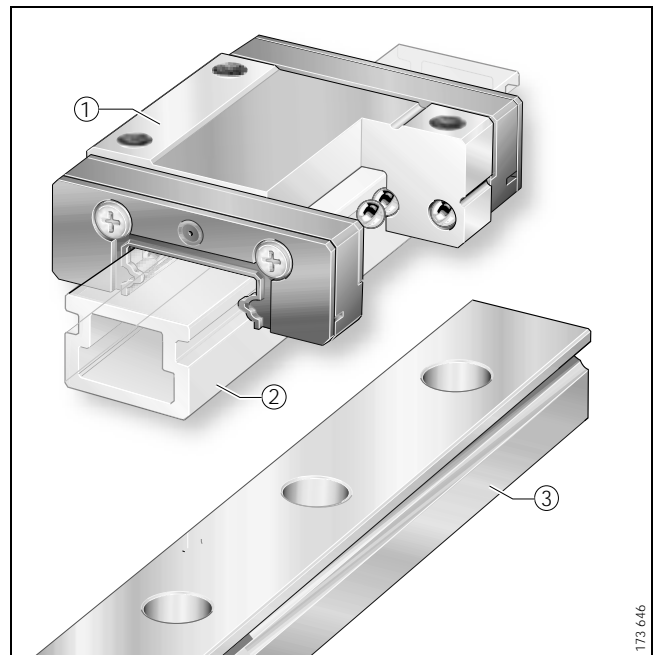


Figure 1 · Delivered condition – guideway, carriage and dummy guideway

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Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Accuracy

Two-row linear recirculating ball bearing and guideway assemblies are available in accuracy classes G1 and G2 (Figure 2).

For accuracy class tolerances, see Table 2 and Figure 2, for reference dimensions see Figure 3.

The tolerances are arithmetic mean values (Figure 2 and Table 2). They relate to the centre point of the screw mounting or locating surfaces of the carriage.

The dimensions H and A₁ should always remain within the tolerance irrespective of the position of the carriage on the guideway.

Table 2 · Accuracy classes and tolerances

Tolerance		Accuracy class	
		G1 μm	G2 μm
for height	H	± 10	± 20
Height difference ¹⁾	ΔH	7	15
for spacing	A ₁	± 15	± 25
Difference in spacing ¹⁾	ΔA ₁	10	20

¹⁾ Dimensional difference between several carriages on one guideway, measured at the same point on the guideway.

Parallelism of raceways to locating surfaces

Parallelism tolerances of guideways: see Figure 2.

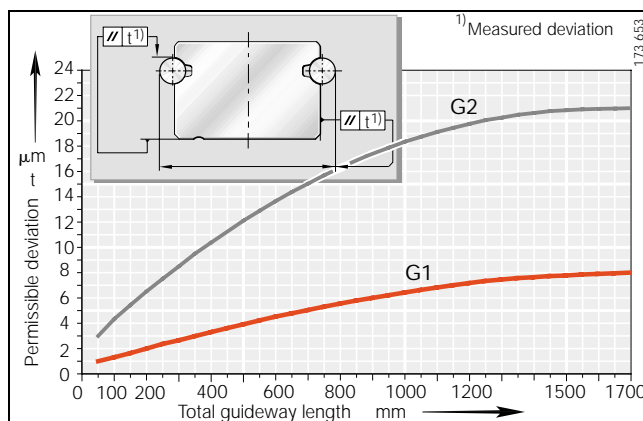


Figure 2 · Accuracy classes and parallelism tolerances of guideways

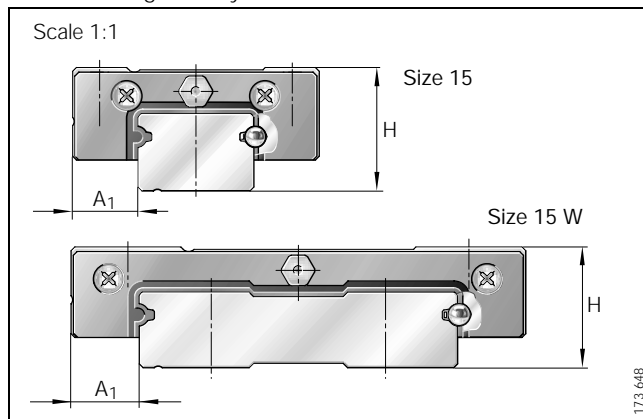


Figure 3 · Reference dimensions for accuracy

Tolerances of guideways

Tolerances: see Figure 4 and Table 3.

Table 3 · Length tolerances

Guideway Designation	Tolerances of guideways
TKDM 5	+0,2 / -2,2
TKDM 5 W	
TKDM 7	
TKDM 7 W	
TKDM 9	+0,25 / -2,25
TKDM 9 W	
TKDM 12	
TKDM 12 W	
TKDM 15	
TKDM 15 W	

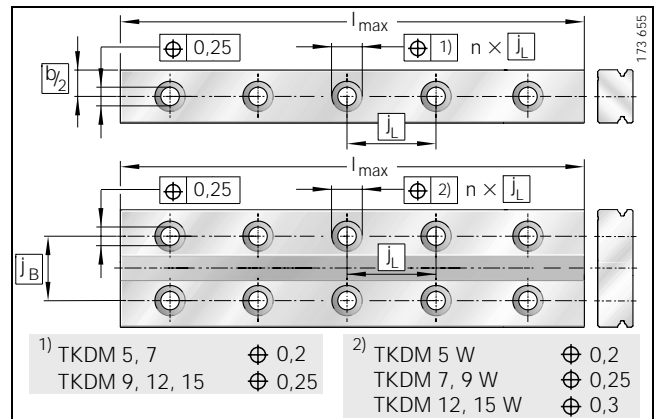


Figure 4 · Positional and length tolerances of guideways - hole pattern to ISO 1101

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

Hole patterns of guideways

The guideways have a symmetrical hole pattern (Figure 5 and Figure 6). With an asymmetrical hole pattern (customer request), the following must be adhered to:

■ $a_L \geq a_{L\min}$ and $a_R \geq a_{R\min}$ (Figure 5, Figure 6).

Maximum number of pitches between holes

The number of pitches between holes is the rounded whole number equivalent to:

$$n = \frac{l_{\max} - (2 \cdot a_{L\min})}{j_L}$$

The distances a_L and a_R are generally determined by:

$$a_L + a_R = l_{\max} - n \cdot j_L$$

For guideways with a symmetrical hole pattern:

$$a_L = a_R = \frac{1}{2} \cdot (l_{\max} - n \cdot j_L)$$

Number of holes:

$$x = n + 1$$

a_L, a_R mm
Distance between start or end of guideway and nearest hole

$a_{L\min}, a_{R\min}$ mm
Minimum values for a_L, a_R according to the *dimension table*

l_{\max} mm
Guideway length

n -
Maximum number of pitches between holes

j_L mm
Distance between holes

x -
Number of holes.

! The minimum and maximum values for $a_{L\min}$ and $a_{R\min}$ must be observed, otherwise the counterbores may be intersected by the end of the guideway.

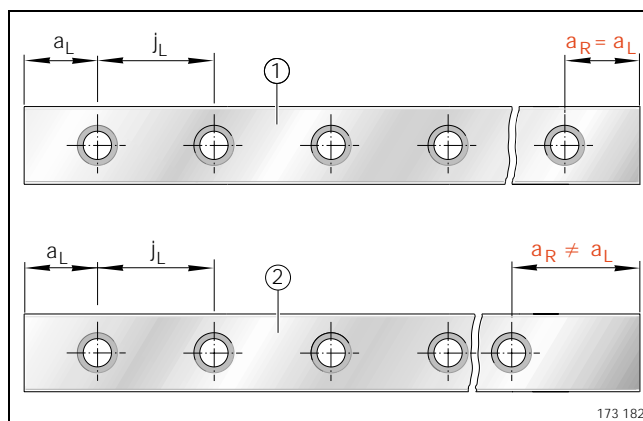


Figure 5 · Symmetrical ① and asymmetrical ② hole patterns for guideways with one row of holes

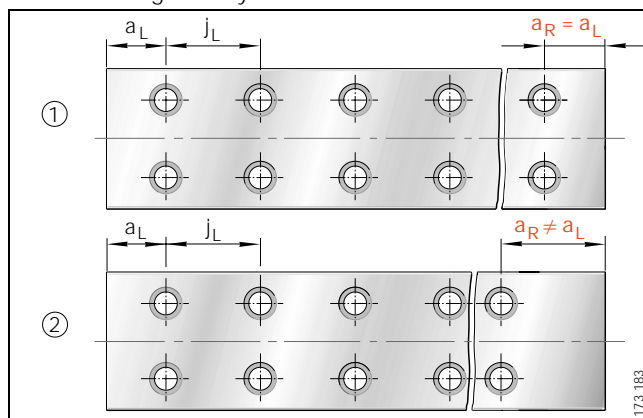


Figure 6 · Symmetrical ① and asymmetrical ② hole patterns for guideways with two rows of holes



Demands on the adjacent construction

The design of the bearing arrangement is essentially determined by the requirements for accuracy, rigidity and load carrying capacity of the bearing arrangement. This has a direct influence on the adjacent construction and primarily concerns:

- the geometrical and positional accuracy of the mounting surfaces
- the location of the guidance elements.

⚠ Ensure that the adjacent construction has adequate strength.

Geometrical and positional accuracy of the mounting surfaces

Observe the tolerances for the support and locating surfaces in Figure 7, Figure 8 and Table 5. Surfaces should be ground or precision milled. A mean roughness value of $R_a 1,6$ should be achieved.

- ⚠ Deviations from the specified tolerances:
- will impair the overall accuracy of the guidance system
 - will change the preload
 - will reduce the operating life of the guidance system.

For ΔH (Figure 7, Figure 8), deviations are permissible in accordance with the following formula. If the deviation is greater than this, please consult INA.

$$\Delta H = a \cdot b$$

ΔH μm
Maximum permissible deviation from the theoretically precise position

a -
Factor, dependent on the size and preload class V0, V1 (Table 4).
Guidance system clearance-free.

b mm
Centre distance between guidance elements.

Table 4 · Factor – dependent on size and preload class

Guideway / carriage Designation	Factor a	
	V0	V1
TKDM 5 (W) / KWEM 5 (C, W, WC)	0,1	0,01
TKDM 7 (W) / KWEM 7 (L, C, W, WL, WC)	0,125	0,02
TKDM 9 (W) / KWEM 9 (L, C, W, WL, WC)	0,175	0,03
TKDM 12 (W) / KWEM 12 (L, C, W, WL, WC)	0,25	0,06
TKDM 15 (W) / KWEM 15 (L, C, W, WL, WC)	0,3	0,15

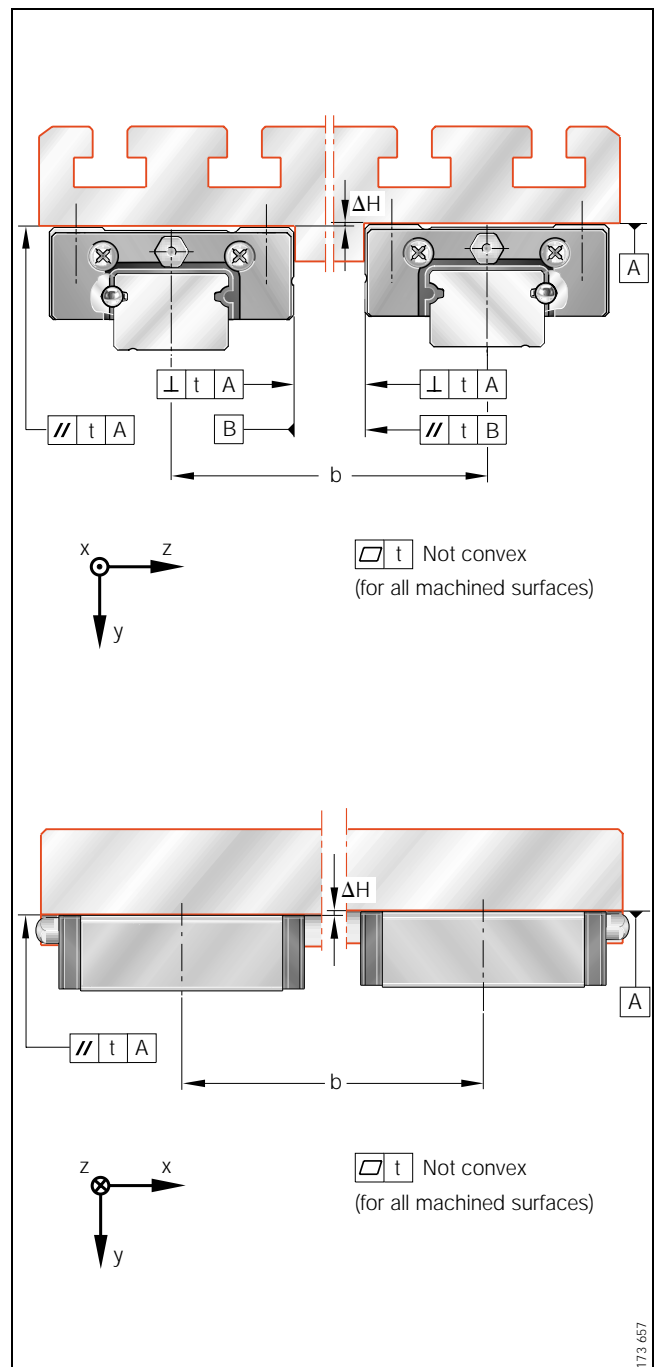


Figure 7 · Tolerances for mounting surfaces

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Parallelism of mounted guideways

For guideways arranged parallel to each other, the parallelism value t given in Figure 8 and Table 5 should be adhered to. If the maximum values are used, this may increase the displacement resistance. If larger tolerances are present, please consult INA.

For calculation of ΔH , see page 11.

Table 5 · Values for t

Guideway Designation	t μm	
	G2	G1
TKDM 5 (W)	30	20
TKDM 7 (W)		
TKDM 9 (W)		
TKDM 12 (W)		
TKDM 15 (W)		

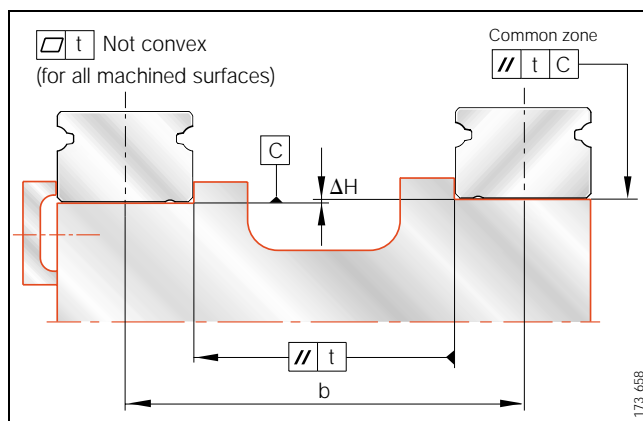


Figure 8 · Parallelism of mounted guideways

Locating heights and corner radii

Locating heights and corner radii should be in accordance with Figure 9 and Table 6.

Table 6 · Locating heights and corner radii

Guideway / carriage Designation	Locating heights and corner radii			
	h_1	$h_2 \text{ max}$	$r_1 \text{ max}$	$r_2 \text{ max}$
TKDM 5 / KWEM 5 (C)	2	0,8	0,3	0,2 ¹⁾
TKDM 5 W / KWEM 5 W (WL, WC)	2	1,2	0,3	0,2 ¹⁾
TKDM 7 / KWEM 7 (L, C)	2,5	1,2	0,2 ¹⁾	0,2 ¹⁾
TKDM 7 W / KWEM 7 W (WL, WC)	2,5	1,2	0,2 ¹⁾	0,2 ¹⁾
TKDM 9 / KWEM 9 (L, C)	3	1,5	0,2 ¹⁾	0,2 ¹⁾
TKDM 9 W / KWEM 9 W (WL, WC)	3	2,5	0,2 ¹⁾	0,2 ¹⁾
TKDM 12 / KWEM 12 (L, C)	4	2,5	0,2 ¹⁾	0,2 ¹⁾
TKDM 12 W / KWEM 12 W (WL, WC)	4	2,5	0,2 ¹⁾	0,2 ¹⁾
TKDM 15 / KWEM 15 (L, C)	4,5	3	0,2 ¹⁾	0,2 ¹⁾
TKDM 15 W / KWEM 15 W (WL, WC)	5	3	0,2 ¹⁾	0,2 ¹⁾

¹⁾ Preferably with undercut.

Sealing

In order to prevent damage to the guidance systems, the raceways must be kept clean at all times. If the wipers used as standard are not adequate for this purpose, additional seals must be provided in the adjacent construction.

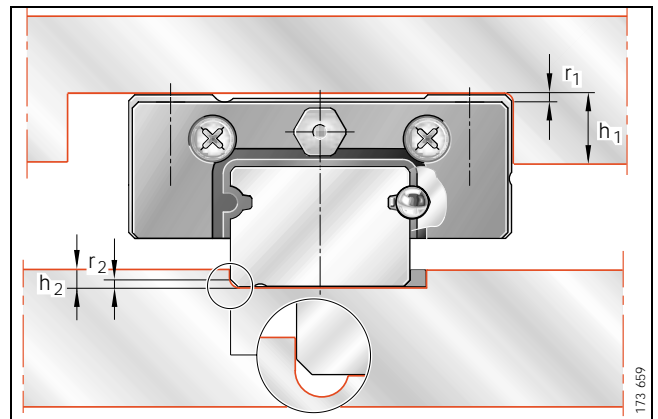


Figure 9 · Locating heights and corner radii

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Accessories

Sealing strips

For applications in a contaminated environment, the carriages can be fitted with sealing strips ①. In this case, the reduced dimension H_1 must be taken into consideration (Figure 10 and Table 7).

Suffix for carriages with sealing strips:

- suffix LD.

Table 7 · Dimension H_1 for fitted sealing strips

Guideway / carriage Designation	H_1
TKDM 9 / KWEM 9 (L, C)	1
TKDM 9 W / KWEM 9 W (WL, WC)	2
TKDM 12 / KWEM 12 (L, C)	2
TKDM 12 W / KWEM 12 W (WL, WC)	2
TKDM 15 / KWEM 15 (L, C)	3
TKDM 15 W / KWEM 15 W (WL, WC)	3

Greasing

Carriages KWEM (W) can also be supplied without greasing:

- suffix UG.

For "clean room" applications, carriages with special grease are available. Please consult INA in this case.

A miniature grease injector is available for carriages with a lubrication hole (Figure 11). This can be supplied with:

- standard grease
 - ordering designation SPRI-KWEM
- "clean room" grease. Please consult INA in this case.

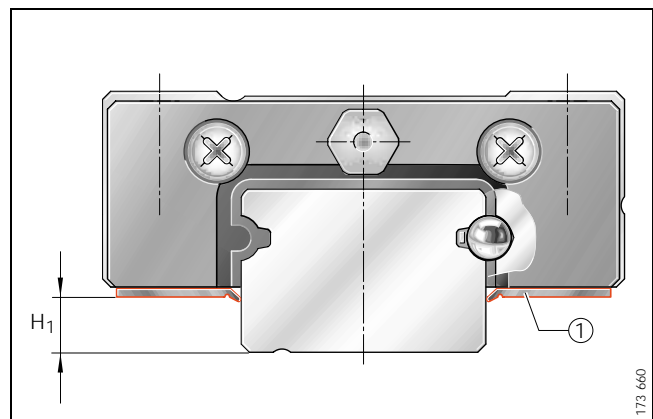


Figure 10 · Dimension H_1

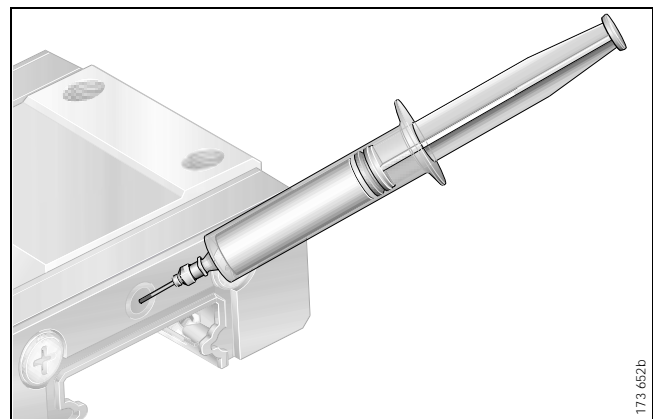


Figure 11 · Grease injector



Ordering example and ordering designation

Example 1:

Symmetrical hole pattern

Accuracy G1, with preload, with sealing strips

Number of carriages 2

Carriage KWEM

Size 9

With sealing strips LD

Accuracy of guidance system G1

Preload class V1

Number of guideways 1

Guideway TKDM

Size 9

Accuracy G1

Guideway length 220 mm

Ordering designation:

2×KWEM 9 LD G1 V1

1×TKDM 9 G1/220 (Figure 12).

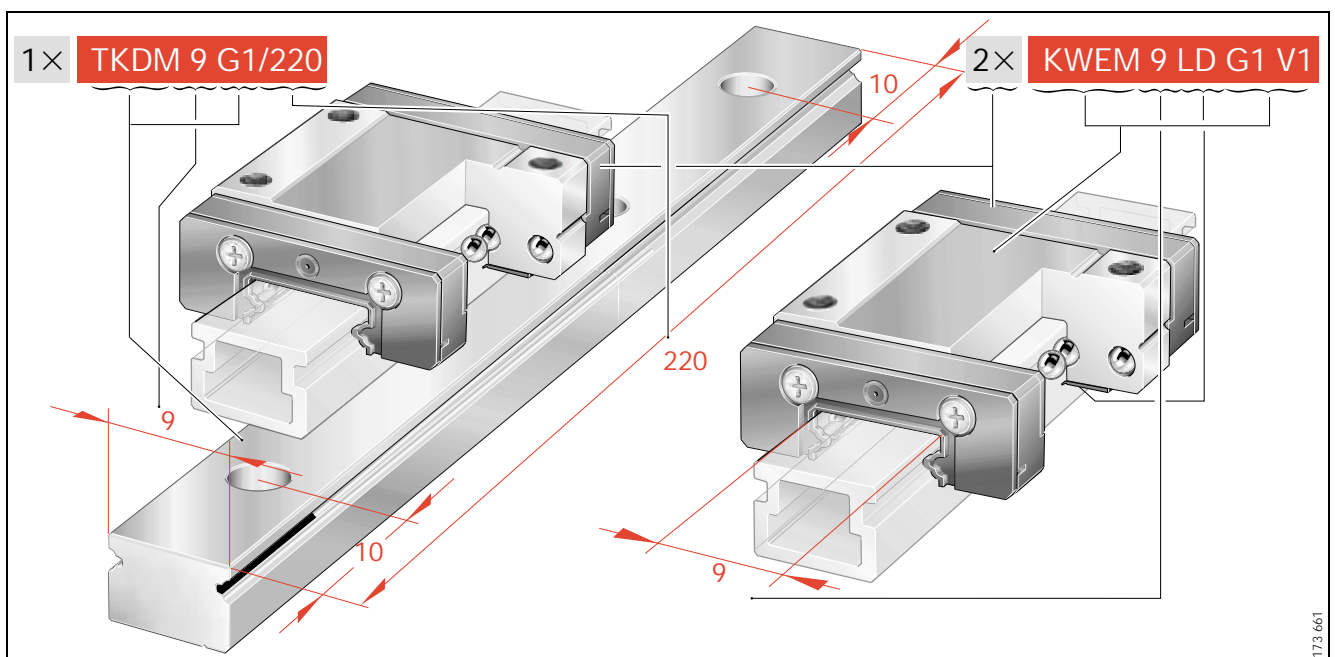


Figure 12 · Ordering example, ordering designation

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Ordering example and ordering designation

Example 2:

Symmetrical hole pattern

Accuracy G2, without preload, wide version, ungreased

Number of carriages 4

Carriage

KWEM

Size

15

Wide design

W

Accuracy of guidance system

G2

Preload class

V0

Ungreased

UG

Number of guideways

2

Guideway

TKDM

Size

15

Wide design

W

Accuracy

G2

Guideway length

240 mm

Ordering designation:

4×KWEM 15 W G2 V0 UG

2×TKDM 15 W G2/240 (Figure 13).

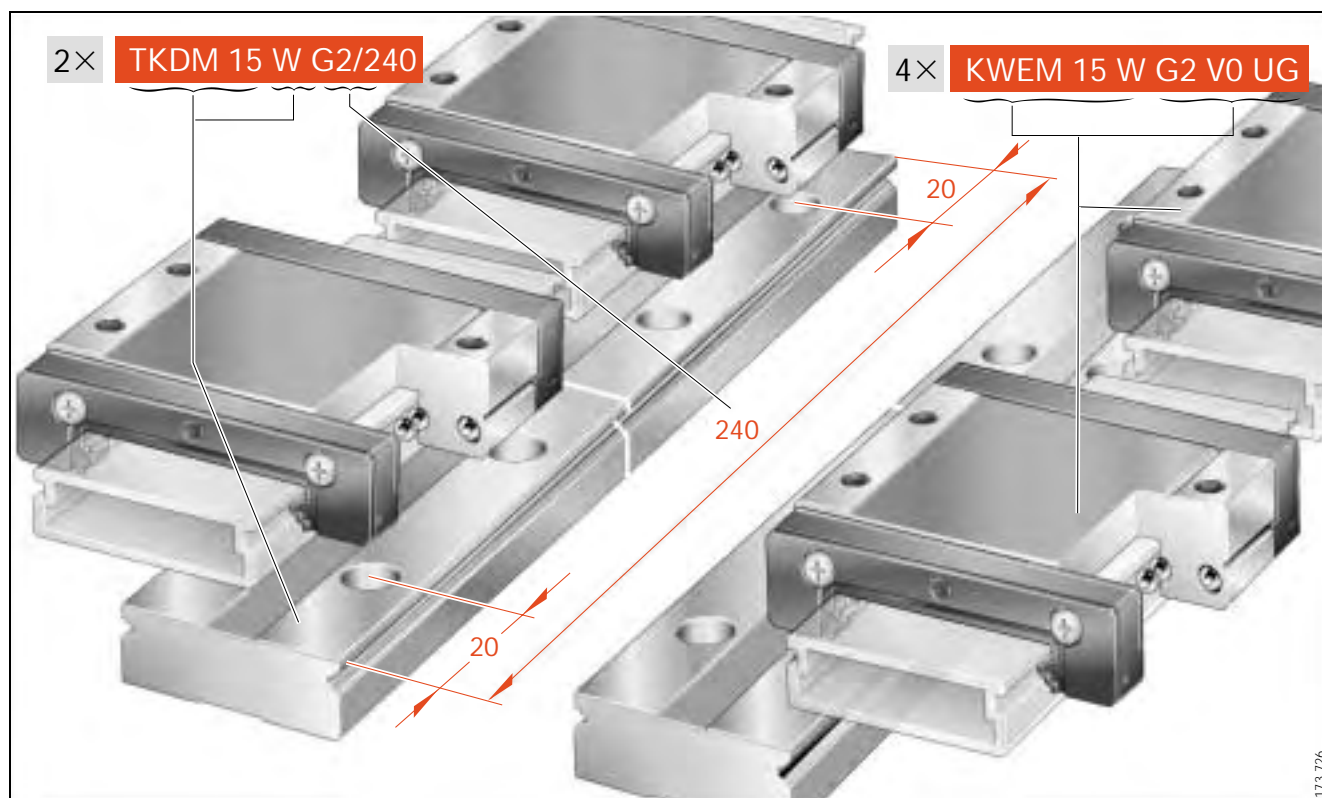
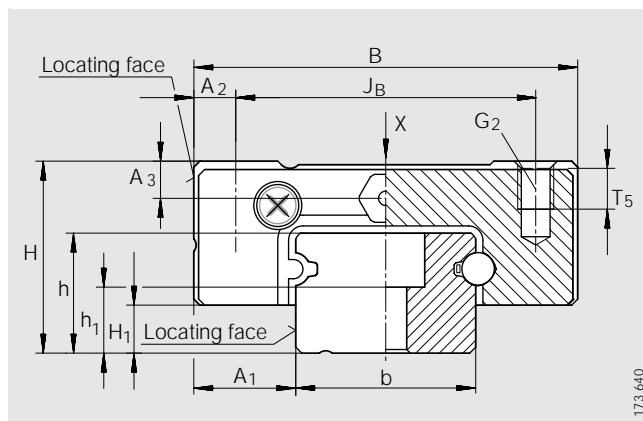


Figure 13 · Ordering example, ordering designation

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

Series KWEM / TKDM



KWEM (L, C) with TKDM

Dimension table · Dimensions in mm														
Carriage		Guideway		Dimensions				Mounting dimensions						
Designation	Mass m ≈kg	Designation	Mass m ≈kg/m	$l_{max}^{1)}$	H	B	L	A ₁	J _B	b	A ₂	L ₁	J _L	j _L
KWEM 5	0,004	TKDM 5	0,120	210	6	12	19	3,5	8	5	2	12,6	–	15
KWEM 5 C	0,003				6	12	16	3,5	8	5	2	9,6	–	15
KWEM 7	0,010	TKDM 7	0,220	300	8	17	23,5	5	12	7	2,5	14,3	8	15
KWEM 7 L	0,014				8	17	31	5	12	7	2,5	21,6	12	15
KWEM 7 C	0,007				8	17	19	5	12	7	2,5	9,6	–	15
KWEM 9	0,019	TKDM 9	0,350	860	10	20	30	5,5	15	9	2,5	20,8	10	20
KWEM 9 L	0,028				10	20	40,5	5,5	15	9	2,5	30,9	15	20
KWEM 9 C	0,011				10	20	21,5	5,5	15	9	2,5	11,9	–	20
KWEM 12	0,035	TKDM 12	0,650	1000	13	27	34	7,5	20	12	3,5	21,6	15	25
KWEM 12 L	0,051				13	27	44	7,5	20	12	3,5	32	20	25
KWEM 12 C	0,022				13	27	25	7,5	20	12	3,5	13	–	25
KWEM 15	0,064	TKDM 15	1,070	1000	16	32	42	8,5	25	15	3,5	27,8	20	40
KWEM 15 L	0,095				16	32	57	8,5	25	15	3,5	42,7	25	40
KWEM 15 C	0,042				16	32	32	8,5	25	15	3,5	17,7	–	40

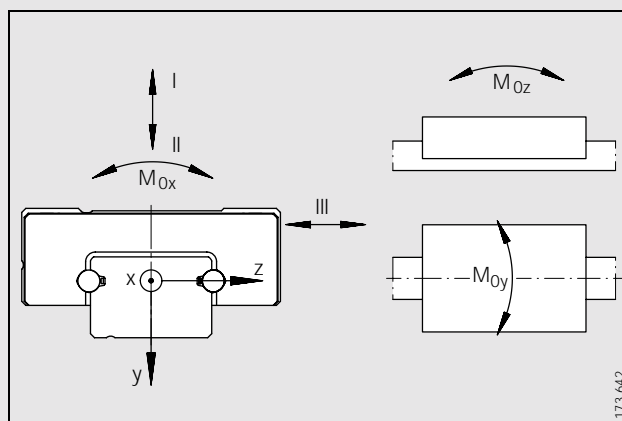
1) Maximum length l_{max} of guideways; longer guideways by agreement.
Available standard lengths: see page 19.

2) If there is a possibility of settling, the fixing screws should be secured against rotation.

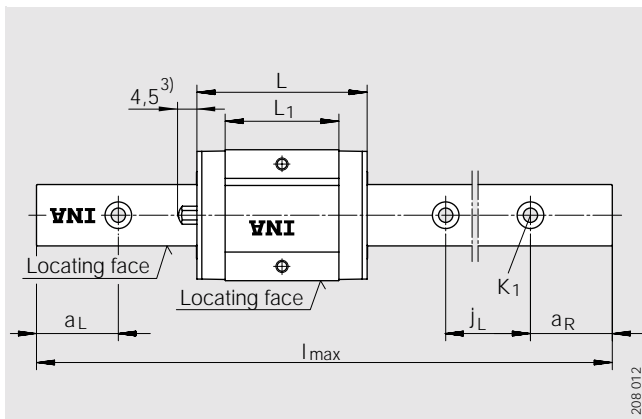
3) A lubrication nipple is included with size 15.

Thread, screw and tightening torques²⁾

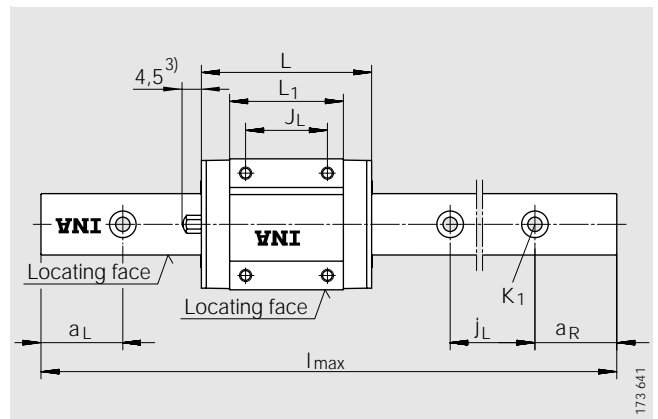
Carriage			Guideway		
Designation	G ₂ for screw ISO 4 762-12.9		Designation	K ₁ for screw ISO 4 762-12.9	
		Nm max.			Nm max.
KWEM 5 (C)	M2	0,6	TKDM 5	M2	0,6
KWEM 7 (L, C)	M2	0,6	TKDM 7	M2	0,6
KWEM 9 (L, C)	M3	2,2	TKDM 9	M3	2,2
KWEM 12 (L, C)	M3	2,2	TKDM 12	M3	2,2
KWEM 15 (L, C)	M3	2,2	TKDM 15	M3	2,2



Load directions



KWEM 5, KWEM...C with TKDM · View X (rotated 90°)



KWEM...L with TKDM · View X (rotated 90°)

										Load carrying capacity					
a _L		a _R		H ₁	T ₅	A ₃	h	h ₁	Basic load ratings				Moment ratings		
									Load directions I and II Tensile and compressive load		Load directions III Lateral load				
min.	max.	min.	max.						C N	C ₀ N	C N	C ₀ N	M _{0x} Nm	M _{0y} Nm	M _{0z} Nm
4	11,5	4	11,5	1	1,5	1,2	3,7	2,9	676	1090	595	916	2,9	1,9	2,3
4	11,5	4	11,5	1	1,5	1,2	3,7	2,9	562	841	495	706	2,2	1,2	1,4
4,5	12	4,5	12	1,5	2,5	1,5	5	2,7	1330	1890	1170	1587,6	6,9	3,9	4,7
4,5	12	4,5	12	1,5	2,5	1,5	5	2,7	1690	2650	1487	2226	9,7	7,4	8,8
4,5	12	4,5	12	1,5	2,5	1,5	5	2,7	937	1140	825	958	4,1	1,5	1,8
4,5	14,5	4,5	14,5	2	3	2,2	6	2,5	1810	2760	1593	2318	12,8	7,6	9,1
4,5	14,5	4,5	14,5	2	3	2,2	6	2,5	2370	4030	2086	3385	18,7	15,7	18,7
4,5	14,5	4,5	14,5	2	3	2,2	6	2,5	1180	1480	1038	1243	6,9	2,4	2,9
5	17,5	5	17,5	3	3,5	2,7	8	3,5	3330	4290	2930	3604	26,6	12,9	15,4
5	17,5	5	17,5	3	3,5	2,7	8	3,5	4310	6200	3793	5208	38,4	25,7	30,6
5	17,5	5	17,5	3	3,5	2,7	8	3,5	2210	2380	1945	1999	14,8	4,5	5,3
5,5	25,5	5,5	25,5	4	4	3,1	10	5,5	4980	6490	4382	5452	50	24,9	29,7
5,5	25,5	5,5	25,5	4	4	3,1	10	5,5	6620	9740	5826	8182	75	53,6	63,9
5,5	25,5	5,5	25,5	4	4	3,1	10	5,5	3490	3890	3071	3268	30	9,8	11,7

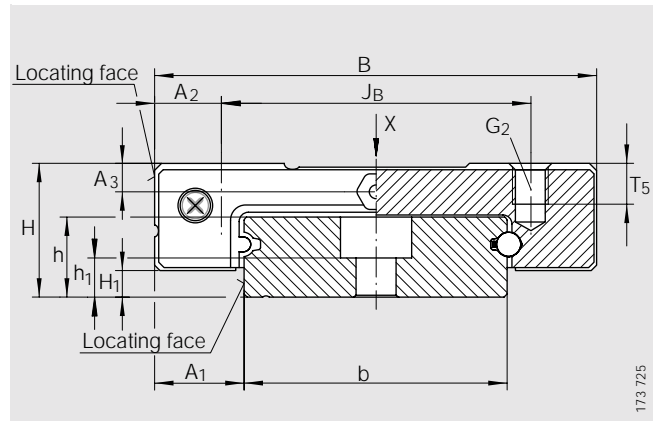
Standard lengths for guideways¹⁾

TKDM 5		TKDM 7		TKDM 9		TKDM 12		TKDM 15	
Lengths	Mass kg	Lengths	Mass kg	Lengths	Mass kg	Lengths	Mass kg	Lengths	Mass kg
60	0,007	60	0,013	60	0,021	100	0,065	160	0,171
90	0,011	90	0,020	80	0,028	150	0,098	240	0,257
105	0,013	120	0,026	120	0,042	200	0,13	320	0,342
120	0,014	150	0,033	160	0,056	275	0,179	440	0,471
150	0,018	180	0,040	220	0,077	350	0,228	560	0,599
210	0,025	240	0,053	280	0,098	475	0,309	680	0,728
-	-	300	0,066	860	0,301	1000	0,65	1000	1,07

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

Series KWEM..W / TKDM..W



KWEM 5/7/9 W (WL, WC) with TKDM 5/7/9 W

Dimension table · Dimensions in mm

Carriage		Guideway		Dimensions			Mounting dimensions							
Designation	Mass m ≈kg	Designation	Mass m ≈kg/m	$l_{max}^{1)}$	H	B	L	A_1	J_B	b	A_2	L_1	J_L	j_L
KWEM 5 W	0,008	TKDM 5 W	0,280	300	6,5	17	24,5	3,5	13	10	2	17,6	-	20
KWEM 5 WC	0,006				6,5	17	20,5	3,5	13	10	2	13,6	-	20
KWEM 7 W	0,021	TKDM 7 W	0,540	300	9	25	31,5	5,5	19	14	3	22	10	30
KWEM 7 WL	0,031				9	25	42	5,5	19	14	3	32,5	19	30
KWEM 7 WC	0,013				9	25	22,5	5,5	19	14	3	13	-	30
KWEM 9 W	0,044	TKDM 9 W	0,900	690	12	30	39	6	21	18	4,5	28,6	12	30
KWEM 9 WL	0,061				12	30	50,5	6	23	18	3,5	40,4	24	30
KWEM 9 WC	0,026				12	30	26,5	6	21	18	4,5	16,6	-	30

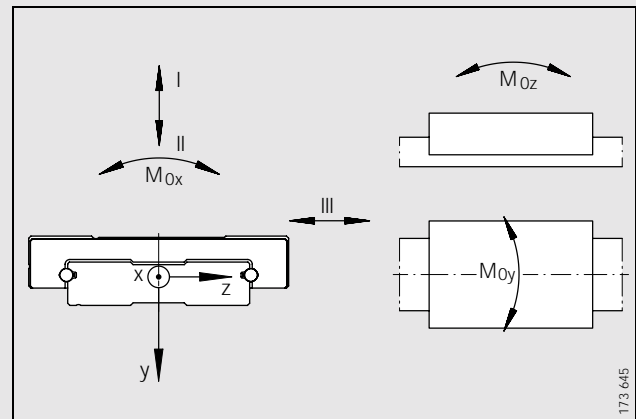
1) Maximum length l_{max} of guideways; longer guideways by agreement.
Available standard lengths: see page 21.

2) If there is a possibility of settling, the fixing screws should be secured against rotation.

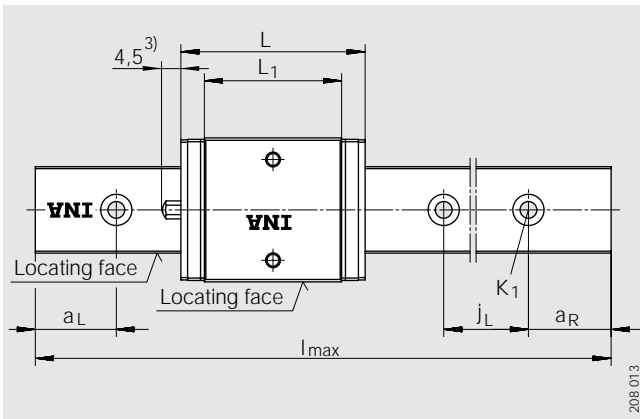
3) A lubrication nipple is included with size 15.

Thread, screw and tightening torques²⁾

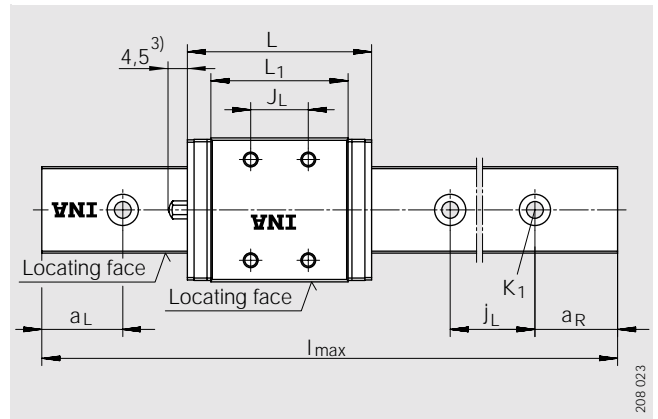
Carriage		Guideway			
Designation	G_2 for screw ISO 4 762-12.9	Designation	K_1 for screw ISO 4 762-12.9		
	Nm max.		Nm max.		
KWEM 5 W (WC)	M2,5	-	TKDM 5 W	M2,5	-
KWEM 7 W (WL, WC)	M3	2,2	TKDM 7 W	M3	2,2
KWEM 9 W (WL, WC)	M3	2,2	TKDM 9 W	M3	2,2



Load directions



KWEM 5 W, KWEM..WC with TKDM · View X (rotated 90°)



KWEM..W (WL) with TKDM · View X (rotated 90°)

									Load carrying capacity							
a _L		a _R		H ₁	T ₅	A ₃	h	h ₁	Basic load ratings				Moment ratings			
									Load directions I and II Tensile and compressive load		Load directions III Lateral load					
min.	max.	min.	max.						C	C ₀	C	C ₀	M _{0x}	M _{0y}	M _{0z}	
										N	N	N	N	Nm	Nm	Nm
4,5	14,5	4,5	14,5	1,5	1,5	1,3	4	2,4	849	1510	747	1268	7,8	3,5	4,2	
4,5	14,5	4,5	14,5	1,5	1,5	1,3	4	2,4	712	1180	627	991	6,1	2,2	2,6	
5,5	20,5	5,5	20,5	2	3	1,7	5,5	2,3	1770	2840	1558	2386	20,3	8,4	10,1	
5,5	20,5	5,5	20,5	2	3	1,7	5,5	2,3	2320	4160	2042	3494	29,8	17,6	21	
5,5	20,5	5,5	20,5	2	3	1,7	5,5	2,3	1240	1700	1091	1428	12,2	3,2	3,8	
5,5	20,5	5,5	20,5	3	3	2,5	7	2,5	2280	3810	2006	3200	34,9	14,2	16,9	
5,5	20,5	5,5	20,5	3	3	2,5	7	2,5	2870	5300	2526	4452	48,5	26,7	31,9	
5,5	20,5	5,5	20,5	3	3	2,5	7	2,5	1510	2120	1329	1781	19,4	4,7	5,5	

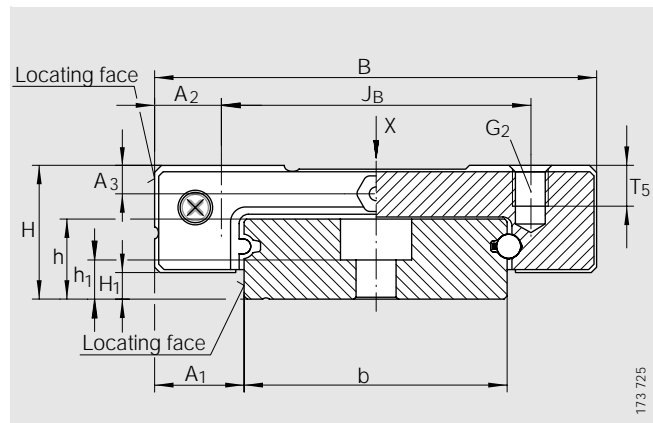
Standard lengths for guideways¹⁾

TKDM 5 W		TKDM 7 W		TKDM 9 W	
Lengths	Mass kg	Lengths	Mass kg	Lengths	Mass kg
60	0,017	90	0,049	90	0,081
80	0,022	120	0,065	120	0,108
120	0,034	150	0,081	150	0,135
160	0,045	180	0,097	180	0,162
220	0,062	240	0,13	240	0,216
280	0,078	300	0,162	300	0,27
300	0,084	-	-	690	0,621

Two-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

Series KWEM..W / TKDM..W



KWEM 12 W (WL, WC) with TKDM 12 W

Dimension table (continued) · Dimensions in mm

Carriage		Guideway		Dimensions				Mounting dimensions							
Designation	Mass m ≈kg	Designation	Mass m ≈kg/m	$l_{max}^{1)}$	H	B	L	A ₁	J _B	b	A ₂	L ₁	J _L	j _L	j _B
KWEM 12 W	0,076	TKDM 12 W	1,390	680	14	40	44	8	28	24	6	31	15	40	–
KWEM 12 WL	0,111				14	40	59	8	28	24	6	46,3	28	40	–
KWEM 12 WC	0,045				14	40	30,5	8	28	24	6	17,7	–	40	–
KWEM 15 W	0,140	TKDM 15 W	2,940	680	16	60	55	9	45	42	7,5	39	20	40	23
KWEM 15 WL	0,204				16	60	74,5	9	45	42	7,5	58,3	35	40	23
KWEM 15 WC	0,095				16	60	41,5	9	45	42	7,5	25,3	–	40	23

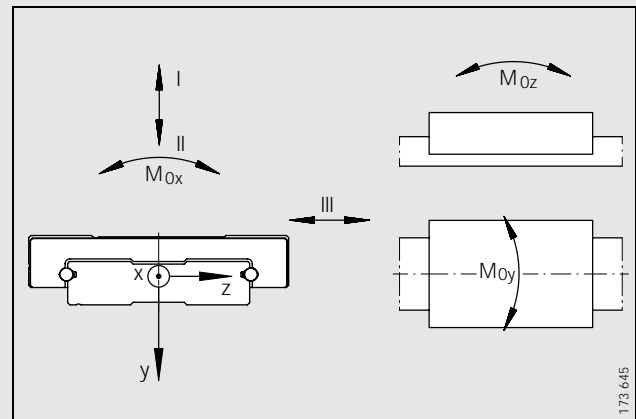
1) Maximum length l_{max} of guideways; longer guideways by agreement.
Available standard lengths: see page 23.

2) If there is a possibility of settling, the fixing screws should be secured against rotation.

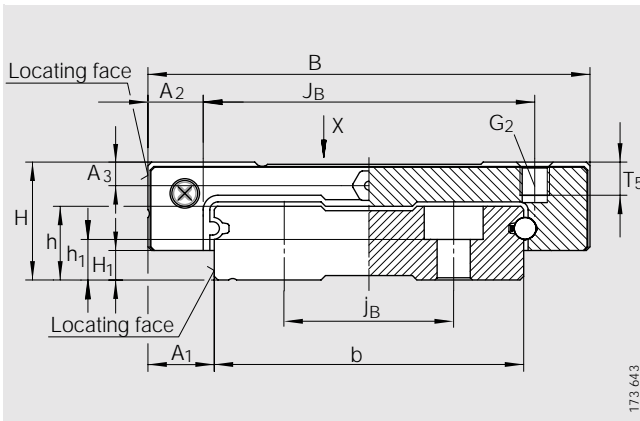
3) A lubrication nipple is included with size 15.

Thread, screw and tightening torques²⁾

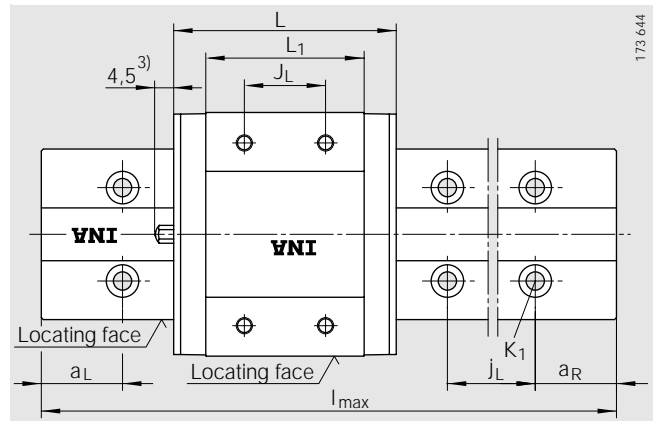
Carriage			Guideway		
Designation	G ₂ for screw ISO 4 762-12.9		Designation	K ₁ for screw ISO 4 762-12.9	
		Nm max.			Nm max.
KWEM 12 W (WL, WC)	M3	2,2	TKDM 12 W	M4	5
KWEM 15 W (WL, WC)	M4	5	TKDM 15 W	M4	5



Load directions



KWEM 15 W (WL, WC) with TKDM 15 W



KWEM 15 W (WL) with TKDM 15 W · View X (rotated 90°)







									Load carrying capacity						
a _L		a _R		H ₁	T ₅	A ₃	h	h ₁	Basic load ratings				Moment ratings		
									Load directions I and II Tensile and compressive load		Load directions III Lateral load				
min.	max.	min.	max.						C	C ₀	C	C ₀	M _{0x}	M _{0y}	M _{0z}
									N	N	N	N	Nm	Nm	Nm
6,5	26,5	6,5	26,5	3	3,5	3,2	8	3,5	4310	6200	3793	5208	75,6	25,7	30,6
6,5	26,5	6,5	26,5	3	3,5	3,2	8	3,5	5620	9060	4946	7610	111	53,1	63,3
6,5	26,5	6,5	26,5	3	3,5	3,2	8	3,5	2800	3340	2464	2806	40,7	8,2	9,7
6,5	26,5	6,5	26,5	4	4,5	3,2	10	5,5	7050	9840	6204	8266	209	51,4	61,3
6,5	26,5	6,5	26,5	4	4,5	3,2	10	5,5	9200	14400	8096	12096	305	106	126
6,5	26,5	6,5	26,5	4	4,5	3,2	10	5,5	5030	6050	4426	5082	128	20,8	24,8

Standard lengths for guideways¹⁾

TKDM 12 W		TKDM 15 W	
Lengths	Mass kg	Lengths	Mass kg
120	0,167	160	0,470
160	0,222	240	0,706
240	0,334	320	0,941
320	0,445	440	1,294
400	0,556	560	1,646
480	0,667	680	2,000
680	0,945	-	-

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

	Page
	Design and safety guidelines..... 26
	Preload 27
	Accuracy..... 28
	Demands on the adjacent construction 30
	Accessories 32
	Ordering example and ordering designation 32



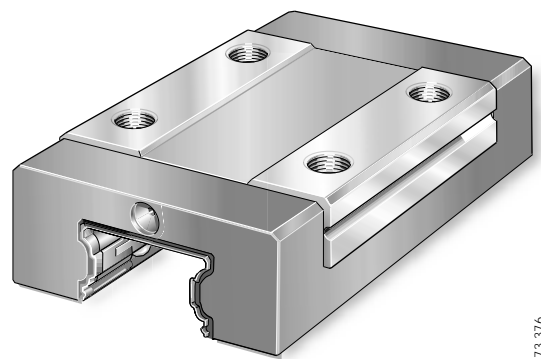
Features

Four-row miniature linear recirculating ball bearing and guideway assemblies

- of this series are complete units comprising:
 - at least one carriage made from corrosion-resistant rolling bearing steel with a full complement ball system and one locating face
 - ball retainers in the carriages
 - a guideway made from corrosion-resistant rolling bearing steel with two locating edges
 - plastic closing plugs for closing off the counterbores in the guideways
- have 4 rows of rolling elements that are in two point contact with the raceways and support forces at a contact angle of 45°
- are linear locating bearings
- can support loads from all directions – apart from the direction of motion – and moments about all axes
- are preloaded
- have gap seals on the end faces of the carriages to seal off the rolling element system
- have a lubricant reservoir in the carriage. As a result, they are maintenance-free for most applications
- are not greased
- are lubricated via lubrication holes in the end piece of the carriage
 - a lubrication nipple is fitted in the end pieces of size 15
- are supplied preassembled
 - there is at least one carriage on one guideway
- are suitable for:
 - accelerations up to 40 m/s²
 - speeds up to 180 m/min
 - operating temperatures from –40 °C to +80 °C.

Carriage – corrosion-resistant

KWME..C



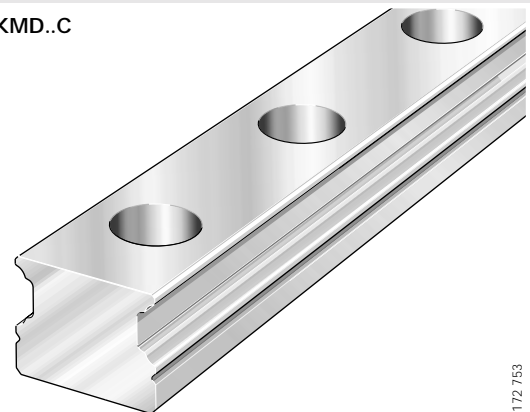
173 376

- saddle plate made from corrosion-resistant, hardened steel, rolling element raceways precision ground
 - balls are recirculated in enclosed channels with plastic return elements
- end pieces with gap seals and lubrication holes
 - lubrication nipple supplied with size 15



Guideway – corrosion-resistant

TKMD..C

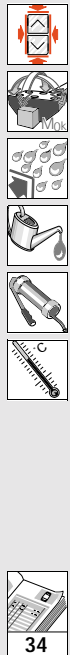


172 753

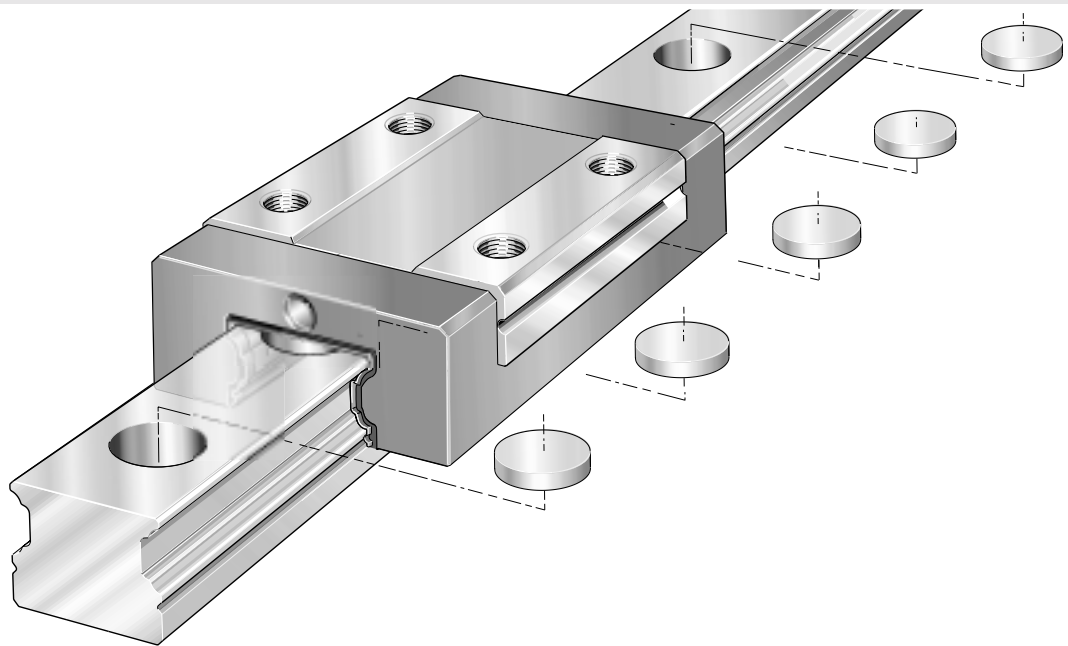
- corrosion-resistant steel, hardened and ground on all faces, rolling element raceways precision ground
- located from above
- one row of holes for fixing screws
 - though holes with counterbores



Four-row miniature linear recirculating ball bearing and guideway assemblies – corrosion-resistant



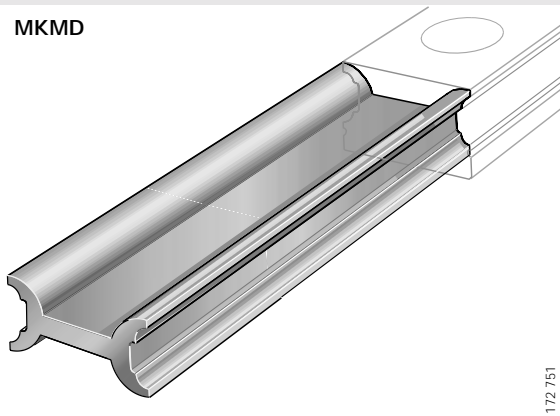
KUME..C



173 377

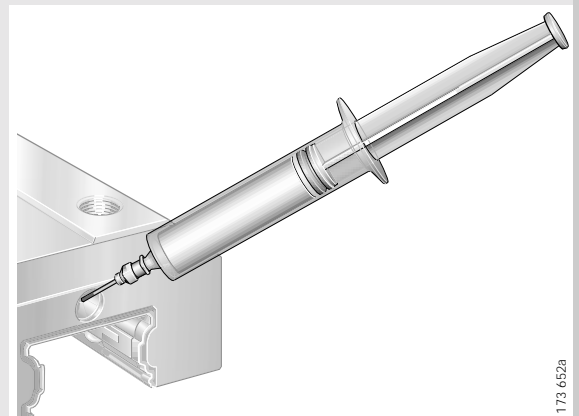
Accessories

MKMD



172 751

- plastic dummy guideway
 - prevents damage to the rolling element set while the carriage is separated from the guideway. The carriages are always pushed direct from the guideway onto the dummy guideway



173 652a

- grease injector for greasing of carriages

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Design and safety guidelines

Load carrying capacity and life

The size of the guidance unit is determined by the load carrying capacity of the individual elements. The load carrying capacity is described in terms of the basic dynamic load rating C and basic static load rating C_0 (*dimension table*).

Basic rating life

The basic rating life is determined as follows:

$$L = \left(\frac{C}{P}\right)^p$$

$$L_h = \frac{8,33 \cdot 10^5}{H \cdot n_{osc}} \cdot \left(\frac{C}{P}\right)^p$$

Static load safety factor

The static load safety factor S_0 indicates the security with regard to permissible permanent deformation in the bearing without affecting the guidance accuracy and smooth running of the bearing.

It can be determined using the following formula:

$$S_0 = \frac{C_0}{P_0}$$

$$S_0 = \frac{M_0}{M}$$



If high demands are placed on accuracy and smoothness of running, the static load safety factor should not be less than $S_0 = 3$.

For high loads, the load carrying capacity of the fixing screws must be checked (see VDI Guideline 2 230).

The equivalent static bearing load is determined by the maximum load F_{max} .

$$P_0 = F_{max}$$

$$M_0 = M_{max}$$

C N
Basic dynamic load rating (*dimension table*)

C_0 N
Basic static load rating (*dimension table*)

H mm
Distance between ends of stroke

L mm
Basic rating life in 100 000 m

L_h h
Basic rating life in operating hours

M Nm
Equivalent static moment in load direction

M_0 Nm
Basic static moment rating in load direction (M_{0x} , M_{0y} , M_{0z} from *dimension table*)

n_{osc} min⁻¹
Number of return strokes per minute

p –
Life exponent $p = 3$

P N
Equivalent dynamic load

P_0 N
Maximum equivalent static load

S_0 –
Static load safety factor.

Conversion

Basic load ratings to DIN, basic load ratings as used in the Far East

Linear recirculating ball bearing and guideway assemblies

$$C_{50000} = 1,26 \cdot C_{DIN}$$

$$C_{DIN} = 0,79 \cdot C_{50000}$$

C_{DIN} N
Basic dynamic load rating C for distance of 100 000 m – definition in accordance with DIN 636

C_{50000} N
Basic dynamic load rating C for distance of 50 000 m.

Delivered condition

Guideways and carriages are supplied assembled. At least one carriage ② is located on one guideway ① (Figure 1).

Miniature linear recirculating ball bearing and guideway assemblies are supplied with a preservative. The preservative is compatible with oils and greases.

Initial operation

The carriage must be oiled or greased before initial operation and protected against solid and liquid contaminants.

Lubrication

Lubrication can be carried out using conventional pointed nozzles.



Grease guns should not be used since the bearing may be damaged by the forces involved.

The carriage should be moved during lubrication, especially when using grease lubrication. This gives uniform distribution of the lubricant.

Excessive greasing has a negative influence on the behaviour of the bearing.

Corrosion-resistant design



The miniature linear recirculating ball bearing and guideway assemblies are corrosion-resistant due to the steels used in the manufacture of the saddle plates and guideways.

If very high levels of corrosion resistance are required, however, the suitability of the unit for the specific application must be investigated.



Preload

Miniature linear recirculating ball bearing and guideway assemblies KUME..C are available in the preload classes according to Table 1.

Increasing the preload has the effect of increasing:

- the rigidity
- the moment load carrying capacity
- the guidance accuracy.

However, preload also influences the displacement resistance and the operating life of recirculating guidance systems.

Table 1 · Preload

Preload class	Preload setting
V0 (standard)	Zero to light preload
V1	Preload

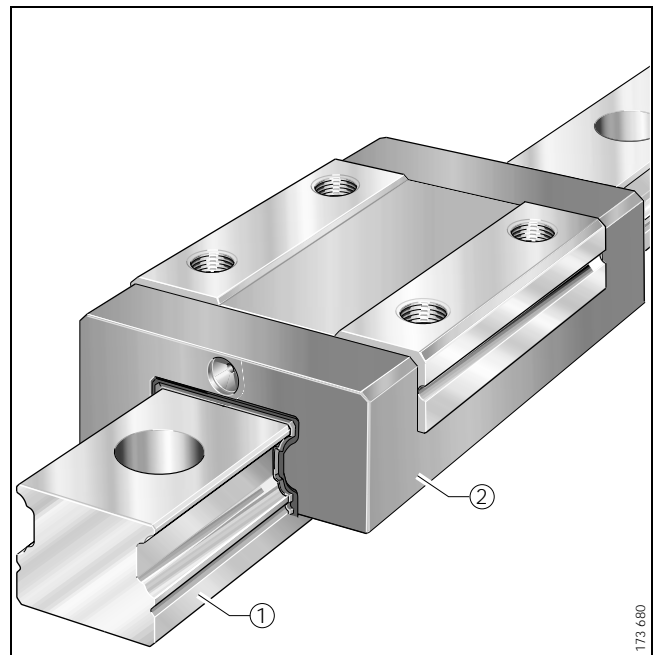


Figure 1 · Delivered condition – guideway and carriage

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Accuracy

Four-row linear recirculating ball bearing and guideway assemblies are supplied in accuracy class G2.

For accuracy class tolerances, see Table 2 and Figure 2, for reference dimensions see Figure 3.

The tolerances are arithmetic mean values (Figure 2 and Table 2). They relate to the centre point of the screw mounting or locating surfaces of the carriage.

The dimensions H and A₁ should always remain within the tolerance irrespective of the position of the carriage on the guideway.

Table 2 · Accuracy class and tolerances

Tolerance		Accuracy class G2 μm
for height	H	± 20
Height difference ¹⁾	ΔH	15
for spacing	A ₁	± 25
Difference in spacing ¹⁾	ΔA ₁	20

¹⁾ Dimensional difference between several carriages on one guideway, measured at the same point on the guideway.

Parallelism of raceways to locating surfaces

Parallelism tolerances of guideways: see Figure 2.

Tolerances of guideways

Tolerances: see Figure 4 and Table 3.

Table 3 · Length tolerances

Guideway Designation	Tolerances of guideways	
	$l_{\max} \leq 300$ mm	$l_{\max} > 300$ mm
TKMD..C	± 0,3 mm	± 0,1% of guideway length

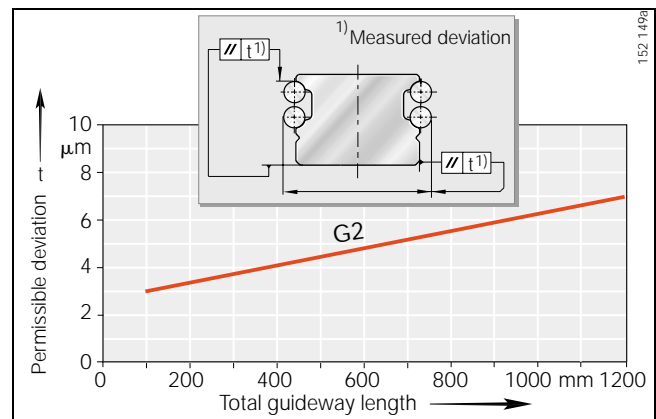


Figure 2 · Accuracy class and parallelism tolerances of guideways

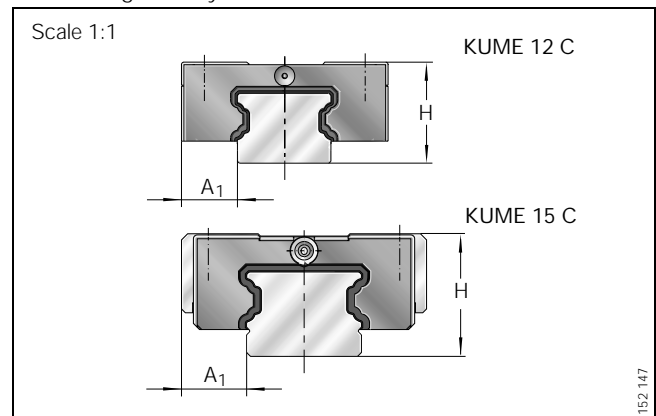


Figure 3 · Reference dimensions for accuracy

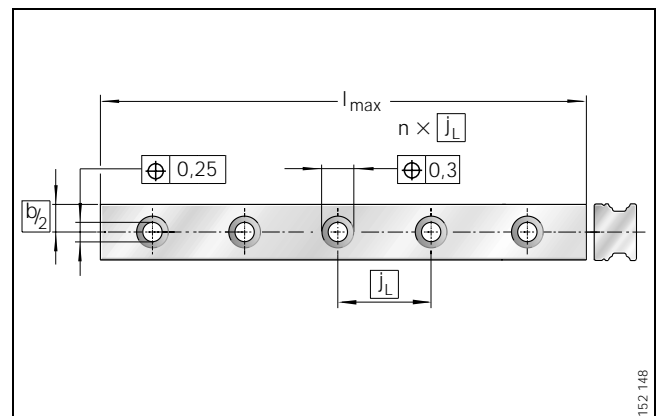


Figure 4 · Positional and length tolerances of guideways - hole pattern to ISO 1101

Hole patterns of guideways

The guideways have a symmetrical hole pattern (Figure 5). For an asymmetrical hole pattern (customer request), the following must apply:

- $a_L \geq a_{L\min}$ and $a_R \geq a_{R\min}$ (Figure 5).

Maximum number of pitches between holes

The number of pitches between holes is the rounded whole number equivalent to:

$$n = \frac{l_{\max} - (2 \cdot a_{L\min})}{j_L}$$

The distances a_L and a_R are generally determined by:

$$a_L + a_R = l_{\max} - n \cdot j_L$$

For guideways with a symmetrical hole pattern:

$$a_L = a_R = \frac{1}{2} \cdot (l_{\max} - n \cdot j_L)$$

Number of holes:

$$x = n + 1$$

a_L, a_R mm
Distance between start or end of guideway and nearest hole

$a_{L\min}, a_{R\min}$ mm
Minimum values for a_L, a_R according to the *dimension table*

l_{\max} mm
Guideway length

n -
Maximum number of pitches between holes

j_L mm
Distance between holes

x -
Number of holes.

! The minimum and maximum values for $a_{L\min}$ and $a_{R\min}$ must be observed, otherwise the counterbores may be intersected by the end of the guideway.

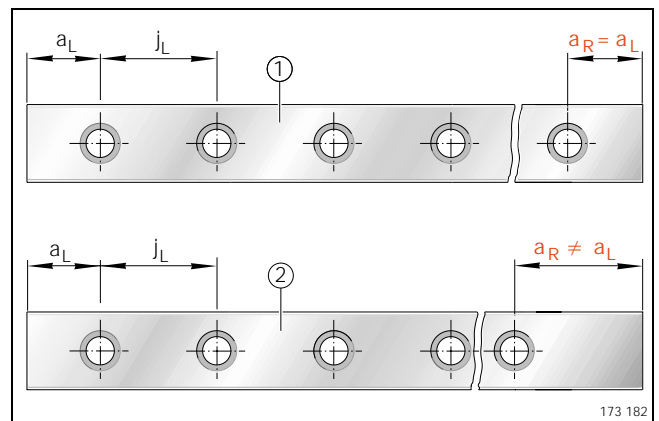


Figure 5 · Symmetrical ① and asymmetrical ② hole patterns for guideways with one row of holes

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Demands on the adjacent construction

The design of the bearing arrangement is essentially determined by the requirements for accuracy, rigidity and load carrying capacity of the bearing arrangement. This has a direct influence on the adjacent construction and primarily concerns:

- the geometrical and positional accuracy of the mounting surfaces
- the location of the guidance elements.



Ensure that the adjacent construction has adequate strength.

Geometrical and positional accuracy of the mounting surfaces

Observe the tolerances for the support and locating surfaces in Figure 6, Figure 7 and Table 5. Surfaces should be ground or precision milled. A mean roughness value of $R_a 1,6$ should be achieved.



Deviations from the specified tolerances:

- will impair the overall accuracy of the guidance system
- will alter the preload
- will reduce the operating life of the guidance system.

For ΔH (Figure 6, Figure 7), deviations are permissible in accordance with the following formula. If the deviation is greater than this, please consult INA.

$$\Delta H = a \cdot b$$

ΔH μm
Maximum permissible deviation from the theoretically precise position

a -
Factor dependent on bearing size (Table 4)
This factor is valid for a guidance system set free from clearance.

b mm
Centre distance between guidance elements.

Table 4 · Factor dependent on bearing size

Miniature ball bearing and guideway assembly	Factor
Designation	a
KUME 12 C	0,05
KUME 15 C	0,1

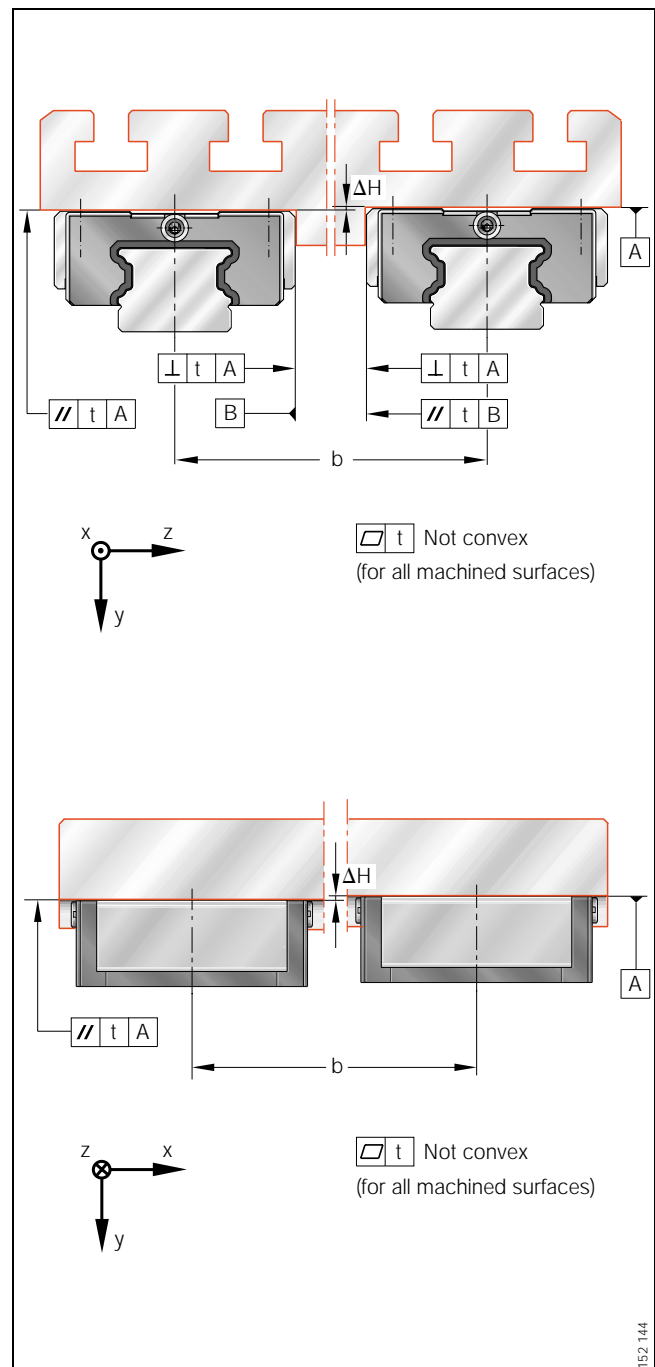


Figure 6 · Tolerances for mounting surfaces

Parallelism of mounted guideways

For guideways arranged parallel to each other, the parallelism value t given in Figure 7 and Table 5 should be adhered to.

If the maximum values are used, this may increase the displacement resistance. For larger tolerances, please consult INA.

For calculation of ΔH , see page 30.

Table 5 · Values for t

Guideway Designation	t μm
TKMD 12 C	5
TKMD 15 C	7

Locating heights and corner radii

Locating heights and corner radii should be in accordance with Figure 8 and Table 6.

Table 6 · Locating heights and corner radii

Miniature ball bearing and guideway assembly Designation	Locating heights and corner radii			
	h_1	$h_2 \text{ max}$	$r_1 \text{ max}$	$r_2 \text{ max}$
KUME 12 C	3	2,5	0,4	0,4
KUME 15 C	5	3	0,7	0,4

Sealing

In order to prevent damage to the guidance systems, the raceways must be kept clean at all times. If the wipers used as standard are not adequate for this purpose, additional seals must be provided in the adjacent construction.

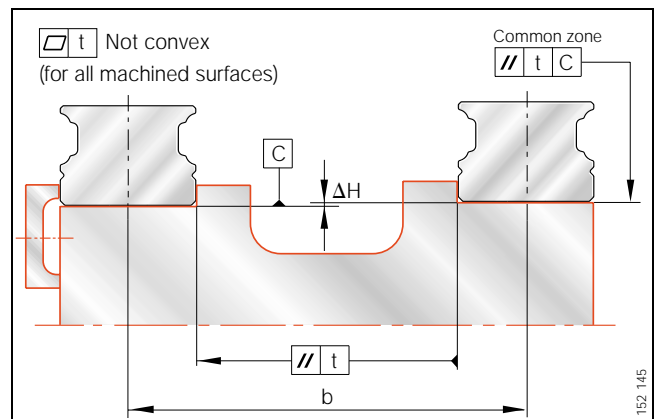


Figure 7 · Parallelism of mounted guideways

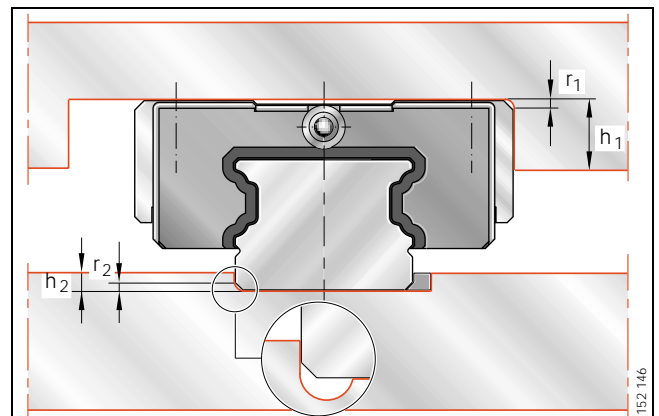


Figure 8 · Locating heights and corner radii

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant



Accessories

The linear recirculating ball bearing and guideway assemblies can be fitted with contact wipers:

- suffix PP.



Ordering example and ordering designation

Asymmetrical hole pattern	KUME..C
Miniature linear recirculating ball bearing and guideway assembly, with clearance	
Size	12
Number of carriages per guideway	W2
Guideway length	215 mm
■ a_L	9 mm
■ a_R	6 mm

Ordering designation:

1×KUME 12 C W2/215-9/6 (Figure 9).

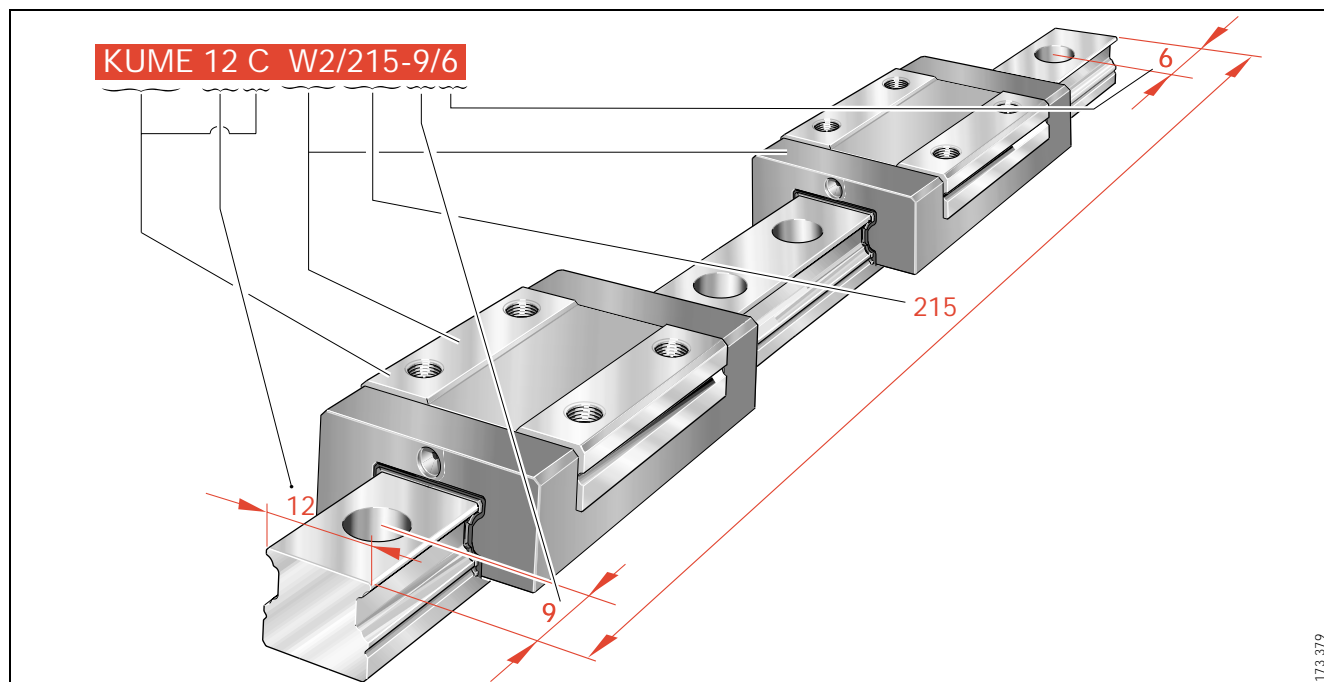


Figure 9 · Ordering example, ordering designation

Four-row miniature linear recirculating ball bearing and guideway assemblies

corrosion-resistant

Series KUME..C

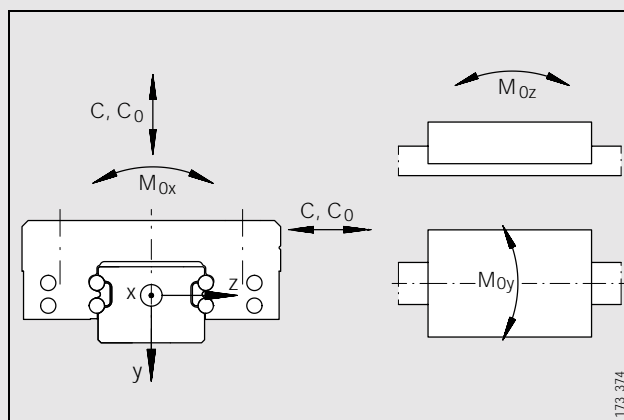
Dimension table · Dimensions in mm															
Carriage		Guideway		Closing plug	Mounting dimensions				Dimensions						
Designation	Mass m ≈kg	Designation	Mass m ≈kg/m		$l_{\max}^{1)}$	H	B	L	A_1	J_B	b	A_2	L_1	J_L	j_L
KWME 12 C	0,03	TKMD 12 C	0,6	KA 6 TN	1000	13	27	35,8	7,5	20	12	3,5	23,2	15	25
KWME 15 C	0,06	TKMD 15 C	1,1	KA 6 TN	1200	16	32	44	8,5	25	15	3,5	28	20	40

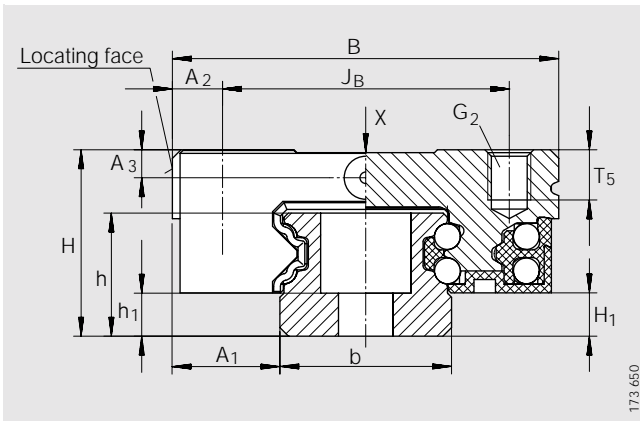
¹⁾ Maximum length l_{\max} of guideways; longer guideways by agreement.

²⁾ If there is a possibility of settling, the fixing screws should be secured against rotation.

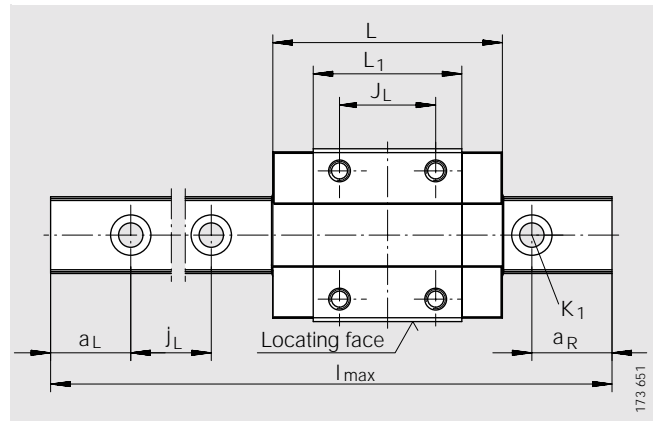
Thread, screw and tightening torques²⁾

Unit Designation	K_1 for screw ISO 4 762-12.9		G_2 for screw ISO 4 762-12.9	
		Nm max.		Nm max.
KUME 12 C	M3	2,2	M3	2,2
KUME 15 C	M3	2,2	M3	2,2





KUME..C



KUME..C · View X (rotated 90°)

									Load carrying capacity				
a _L		a _R		H ₁	T ₅	A ₃	h	h ₁	Basic load ratings		Moment ratings		
min.	max.	min.	max.						C	C ₀	M _{0x}	M _{0y}	M _{0z}
5	20	5	20	3	3,5	1,95	8,6	3	2900	5200	33	17	17
6	34	6	34	3,5	4	2,46	10,6	4,1	4400	8300	67	34	34



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